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PRINTING TO-DAY

JOHN C. TARR

With an Introduction by
FRANCIS MEYNELL

and a note on Modern Typography by
BERTRAM EVANS

GEOFFREY CUMBERLEGE
OXFORD UNIVERSITY PRESS

Oxford University Press, Amen House, London E.C.4
GLASGOW NEW YORK TORONTO MELBOURNE WELLINGTON
BOMBAY CALCUTTA MADRAS CAPE TOWN
Geoffrey Cumberlege, Publisher to the University

First printed	.	1944
Reprinted .	.	1945
Revised edition	.	1949

Printed in Great Britain
by J. and J. Gray, Edinburgh

INTRODUCTION

BY FRANCIS MEYNELL

RHETORIC, according to the American definition, is 'the art of making deep sounds from the chest seem like important messages from the brain.' This is a book without rhetoric. It is necessary to give this key to its contents because printing has always been an enthusiasm as well as a trade or craft or art. Mr. Tarr uses no eloquence to promote, but instead sets out to satisfy, enthusiasm.

Printers have long known their trade as 'the art.' And in 1677-85 Moxon called his handbook *Mechanick Exercises.* Here you have two views which are not contradictory. For printing *must* be mechanical and *can* produce a work of art. It must be mechanical even if it is what is now called 'hand-' printing; and remember that when he recognised the mechanic element in the art Moxon was still confined, with scarcely a change or improvement, to the self-same 'hand' process of type-making, type-setting and type-printing which the first printers had invented, with never an inkling of type-setting machines and automatic presses.

In its first nature, then, printing was mechanical; but because 'the artist' wasn't yet puffed up and puffed out in the style and presumption which he has claimed in the past hundred years, artistry was not then secluded in the so-called 'fine arts,' but was available to the printer and to other honest fashioners and makers. In our time it has been left largely to the interest of the amateur or professional entrepreneur, rather than to the printer himself, to keep alive the artistry of printing and to think in terms of product rather than of process.

It is the function of this book to deal with process; deliberately it leaves out of consideration the wily-beguilies of aesthetics and style. But even so, Mr. Tarr has a sizeable lump in his hands. When printing was but one process instead of three—for intaglio and lithography are added now to letterpress—when its mechanics were simple instead of complex, Moxon found that he had need of 400 pages; and Johnson, for his *Typographia* (1824) used 1,200 pages for the exposition of his theme; whereas Mr. Tarr has compacted his multiple subjects into 183 pages. Readable pages, too, I think you will find them. I have spent most of my life in the designing of books and pamphlets and advertisements, and that has given me some knowledge of letterpress. From Mr. Tarr's ability to be 'curt, clear and complete' about this side of the subject I am

justified in inferring that what appears balanced and comprehensive in his treatment of intaglio and lithography is as sound as it seems.

You who read this book may be influenced by it to seek in printing, or in any of its allied occupations or enterprises, a trade or craft or art for your own occupation. If that is so you will have a right to feel that you are dealing with specially significant things. For two reasons. The first reason is that printing, although it is a method of wide diffusion, of making manifold as well as manifest, has always been an art intimate and singular for those who practise it. It is a creative act, this patterning of marks on paper to make sense, and handsome sense too; so that a book becomes (like George Herbert's Sunday) 'a box where sweets compacted lie.' It is a creative act because a page or paragraph can be an invention, a discovery, in its treatment—*my* invention, *my* discovery—and because of the power of multiplication. If art is imitation, as Plato held, printing is a double art: for it imitated calligraphy, and in the run-on of an impression one sheet significantly imitates another.

And the second reason is that printers can hold in their hands lamps and torches, or they can hold smoke-pots and firebrands. Which is why dictators quickly put them under censorship and make them prisoners of the mind or of the body. The spoken word, though it be spoken to millions of wireless sets, carries no record of the lie, or the promise, or the rare truth. But printing is the great recorder, as more than one newspaper-lord has discovered to his own chagrin. The files survive, the evidence is available and the story is made history; printing has the last word.

Though its nature and principles are not for discussion here, I cannot keep *design* out of my last paragraph—my King Charles' head though it be. (Mr. Tarr himself couldn't keep it out of his last pages.) Unless English manufacturers abandon their complacent attitude towards design—which in a machine-age has superseded 'craftsmanship' as a fact, though many still retain the anachronistic word as a mere label—they, and we with them, are going to have a sorry time when world trade flows again. It happens that printing in England has managed to save its soul alive; it can hold its head up in any international company. For printing has had this job of mating design to the machine for 500 years; it has grown up with it; and its success has lessons for many other much younger trades. Mr. Tarr's book is illuminating about process; and knowledge of process should (in our functional age) lead on to design which is ever more fit, handsome and even generous.

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ACKNOWLEDGMENTS

THE author gratefully acknowledges his indebtedness to all those who have willingly co-operated (often under difficult circumstances) in the making of this book:

Art and Industry (F. A. Mercer); Ebenezer Baylis & Son Ltd. (F. Russell Baylis); *The British Printer*; Dawson, Payne & Elliott Ltd. (H. Payne); The Distillers Company *Gazette* (*Ed.* B. C. Young); Bertram Evans (for valuable advice, practical help, and the Note on Modern Typography); The Favil Press (G. Culliford); R. B. Fishenden (who kindly read the proofs, offered helpful criticism, and suggested valuable additions and emendations in this revised edition); Victor Gollancz Ltd.; The Hoe Rotary Co.; Dr. V. G. W. Harrison (of The Printing & Allied Trades Research Association) whose constructive criticisms have been incorporated in this second edition; The Leicester School of Art & Crafts; Linotype & Machinery Ltd. (W. M. Bower, who also supplied the drawing of the papermaking machine); The London School of Printing (F. W. Clulow for Plates I & II); Geo. Mann & Co. Ltd. (Andrew Wilson); Francis Meynell; The Miehle Press & Manufacturing Co. Ltd. (H. O. Wall); The Monotype Corporation Ltd.; John Swain & Co. Ltd. (Leslie Holt); and The Sun Engraving Co. Ltd. (A. G. Symmons).

CHAPTER I

PRINTING TO-DAY

PRINTING to-day is, both culturally and commercially, essential to human life and progress. Consider how modern man is served by it at almost every moment of the day:

His eyes open to the coloured print hanging on his bedroom wall; he enters the bathroom to use tooth-paste from a printed tube that was originally enclosed in a printed carton; he finds his daily newspaper on the breakfast table, and begins his meal with a cereal from a printed packet; his letters (with their printed stamp) include, perhaps, some printed advertising circular, or (less flattering) a demand note for taxes or some other printed bill. He leaves home, passing posters and bills on the way to the station, where he will need a printed ticket or season ticket, or he may use one of the two million bus tickets issued daily by the London Passenger Transport Board. On his arrival at the office he has to deal with several kinds of printed stationery (letter-headings, invoices, filing cards, memos); at lunch he chooses his meal from a printed menu, and pays his printed bill; later, on his way home, he buys a magazine for his wife (who may have spent her day and her printed pound notes paying a few printed bills); after dinner he settles down with a book. The reader may, doubtless, be able to multiply these instances of an average man's daily contact with printing. So efficiently is he served by the printed word that the absence of the daily newspaper, for example, will almost certainly be ascribed to some fault in the delivery service of the local newsagent rather than to a breakdown in any of the highly specialized processes which went to its production, from the electric teleprinter that receives the news from the news agencies, to the rotary presses roaring at 20,000 revolutions and producing 360,000 copies in an hour.

Every kind of printed matter is produced by one or other of three basic processes illustrated in Figure 1. In certain exceptional instances, a combination of them is used.

In the first method, printing from RELIEF or a raised surface, the ink is applied to the raised surface, the non-printing areas being on a lower plane. The principle is the same as in the rubber stamp. In the second process, printing from a PLANOGRAPHIC surface, the ink is applied to a dead level plate, but the plate is treated so that

only the image to be printed receives the ink and no ink adheres to the parts of the plate which are not to be represented. In the third method, printing from an INTAGLIO or depressed surface, the ink is flooded into an image which has been cut out or etched into the plate. The face of the plate is supported by reticulations so that after the ink is applied to the plate the surface may be scraped, leaving the ink in the sunken parts. The ink is then transferred to the paper by pressure.

Printing from a *relief* surface or LETTERPRESS (as it is commonly called) is the oldest and most widely used process to-day. Newspapers, most books, and the larger part of general printing are printed by this method. It may be identified by its sharp clean impressions, particularly when the type is new (as with type produced on composing and casting machines) and the work is printed from the type. No other process is as flexible; corrections and other alterations to the units that make up the printing surface may be made at any time. Neither is the process limited to the use of printing type (or 'letter' as the early printers called it). 'Blocks,' either 'line' (reproduced from pen and ink drawings), 'half-tone' (reproduced from photographs, paintings, wash drawings, or other continuous tone subjects), wood-cuts, wood-engravings, linoleum and rubber cuts, all being in relief, may be used with or without type.

The earliest kind of *planographic* printing was LITHOGRAPHY, which was (as the name implies) printed from stones. This process depends on the fact that grease and water will not mix, and the affinity of calcareous stone for either grease or water. The image was drawn in lateral reverse directly on to the stone with a greasy chalk and fixed there. In printing, the oily printing ink adhered to the image only; the non-printing parts of the stone were kept resistant to grease by moistening before inking each time a print was made. Later it was found that stone (which was heavy, easily broken and awkward to store) could be replaced by thin metal plates, and the plates bent around a cylinder and adapted to rotary printing presses. The name 'lithography,' however, still persisted, even in the later developments such as photo-lithography (where the printing image is transferred to the metal plate photographically), and in photo-litho-offset (where an impression is made on to a rubber-blanket cylinder and transferred, or 'offset,' from this cylinder to the paper). Future chemical research may discover that new agents may be used such as in the short-lived 'Pantone' process, a planographic method of printing in which mercury was used to repel the

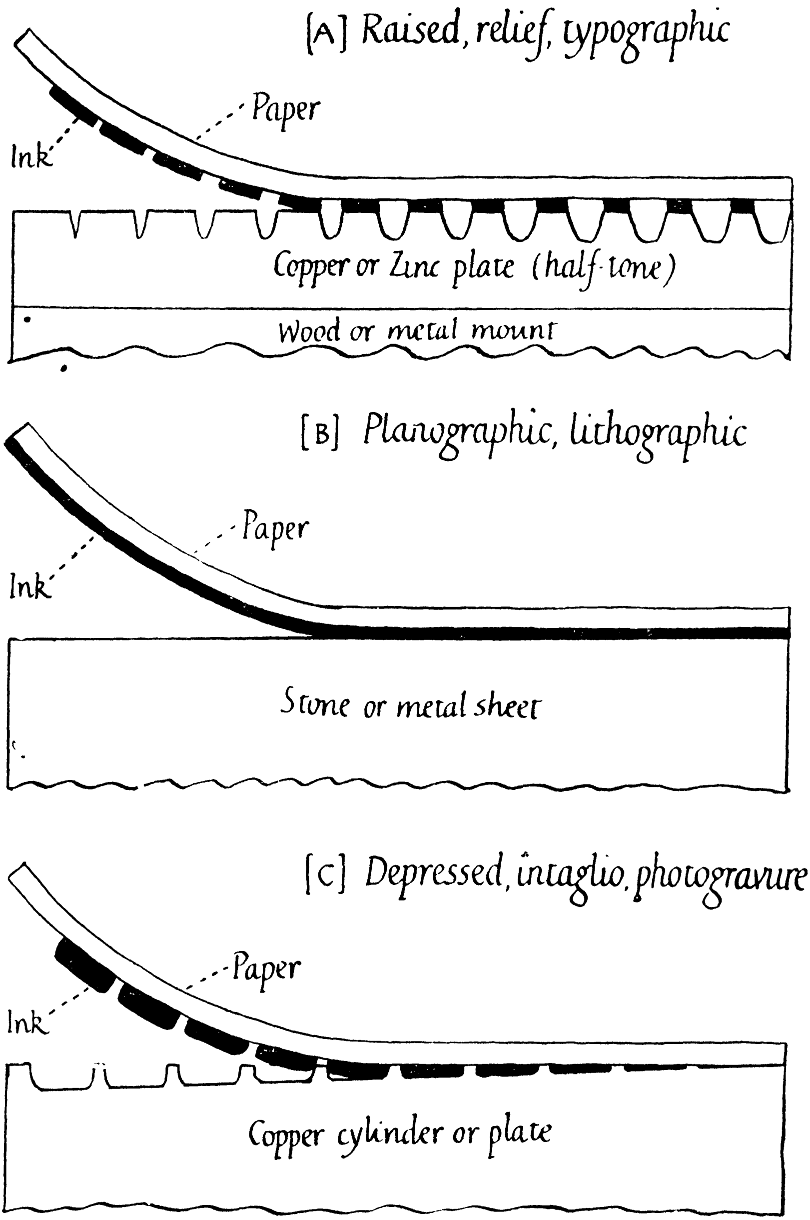


FIG. 1.
Diagrams showing the basic differences between the three main kinds of printing surfaces.

ink from the non-printing areas. Lithographic printing is free from impression or squash marks, and neither type matter nor half-tone dots are quite sharp (Plates I and II). Minute dots may sometimes be seen on those parts of the paper that should be blank.

INTAGLIO printing (photogravure or rotagravure, and the several non-photographic etching processes described in Chapter V) is printed from copper plates or cylinders which are etched. As the printed impressions are made from the ink remaining in the depressed (or etched away) parts of the plate, the surface is provided with a reticulated ground in photogravure, or a screen of cross-sectional parallel lines in rotagravure (as rotary photogravure is called). Intaglio printing processes are used where photographic reproduction is required on cheap papers. It came rapidly into favour about ten years ago, and *Picture Post* may be taken as an example of its use. Intaglio printing may be distinguished by the depth of the shadows in the pictures and a general thickening in the appearance of the type face. The dots or squares of depression made by the screen, it will be noticed (Plates I and II), are equal in size but vary in intensity of colour, and the lines are only a quarter of the width of the squares. In half-tone letterpress the dots (Plate II) vary in size, being smaller in the highlights and larger in the solids (where they often merge).

The primary duty of printing, being a process of making a number of copies, is to disseminate, widely and cheaply, every kind of information and knowledge. It has been said that printing is the most responsible of our social, industrial, and intellectual mechanisms, and that it should (like a transport system) be most disciplined and most rational. The printer, who is entrusted to perform the service of communicating thought, is therefore a sort of public servant.

The history of printing has too often been recounted in terms of the book with but little reference to the varied kinds of ephemeral printing which have considerably influenced printing practice and technique. A very large proportion of printing to-day is of this kind. This field, as well as that of the book and the newspaper, provides ample opportunities for the exploitation of all printing processes.

CHAPTER II

THE HISTORY OF LETTERPRESS PRINTING

THE first attempts to multiply impressions were made in the East, where carved or engraved stamps were used to mark tablets and pottery. These stamps or seals were widely used by the early civilizations of Sumeria, Babylonia, and Egypt to impress designs or letters on clay and wax, and inked impressions were made on papyrus and other materials. Scribes and officials used seals to authenticate documents and to 'seal' granaries and stores.

Early seals were cut in intaglio, and when pressed into a soft substance would make a mould in relief. From such a raised surface, which could be inked to make an impression (a method used by the Romans for authenticating documents), to the wood-cut is an obvious step.

One of the earliest extant block prints is that printed in Japan in A.D. 764. Some two million copies, containing a Sanskrit charm in Chinese characters, were ordered by the Empress Shiyautoku to be placed in little wooden pagodas for distribution among her people.

Although baked clay types were made by Pi Sheng in China in the eleventh century, types were not used widely there, no doubt because the forty thousand or so characters in the Chinese language would make typesetting too involved. The fact that our Roman alphabet contains but twenty-six letters simplified the task in Europe.

Block printing was practised in the East for several centuries before it came to Europe, and the art was probably brought by caravan through Samarkand, Persia, and Syria, the route by which Chinese silk came to Imperial Rome. The Roman missionaries to China at the end of the thirteenth century and such travellers as Marco Polo no doubt brought back examples of printing.

The first block printing in Europe appears to have been playing-cards and religious pictures, which were sold at various shrines and by travelling pedlars and palmers. Pilgrimages were encouraged by the Popes who permitted certain shrines to grant indulgences to visitors. The wide use of playing cards is evidenced by their prohibition in many German towns between 1380 and 1410, and it may be that the religious prints were intended to act as an antidote against their influence and to provide an alternative source of trade to those who printed them.

The early religious block prints were printed in outline and often subsequently coloured by hand. Famous examples are the *Bois Protat* (*c.* 1370) in the possession of M. Jules Protat of Mâcon (which was probably used for printing on fabric), the *Brussels Virgin* (*c.*1418), and (Fig. 2) the *St. Christopher* (1423) in the Rylands Library at Manchester, which is the earliest existing dated wood-block print.

These blocks were cut with a knife on plank wood, inked with a thin watery ink, covered with a sheet of dampened paper, and rubbed or dabbed with a small stuffed cushion. They were followed by 'block books' which were made by pasting the prints back to back or printing them on both sides of the paper in the printing press.

FIG. 2.
The earliest existing dated European wood-cut. St. Christopher fording a river with the infant Christ (1423).

It would be convenient to show that these picture prints (which soon began to include wording) were a natural prelude to printing from movable types and that the difficulty of correcting mistakes in a solid block led to the use of separate type letters. But few of these block books were printed before the invention of movable types, and there is little doubt but that they were contemporaneous and that their development was independent, for they continued to be issued for a century after letterpress printing was invented.

There are in existence about thirty of these block-book editions, the most famous being the *Biblia Pauperum*, *c.* 1465 (which showed scenes from the Old and New Testaments accompanied by appropriate texts), the *Apocalysis Sancti Johannis*, the *Speculum humanæ salvationis* (sometimes ascribed to the Dutch claimant to the invention of printing, Coster of Haarlem), and the *Ars Moriendi* (a

PLATE I

Type Printed by Letterpress on a super-calendered paper (*magnified* 15 *times*).

Note the clean, sharp outline, and the blacker rim of ink around each letter caused by the ink being pressed to the edge of the type face thus forming a ridge.

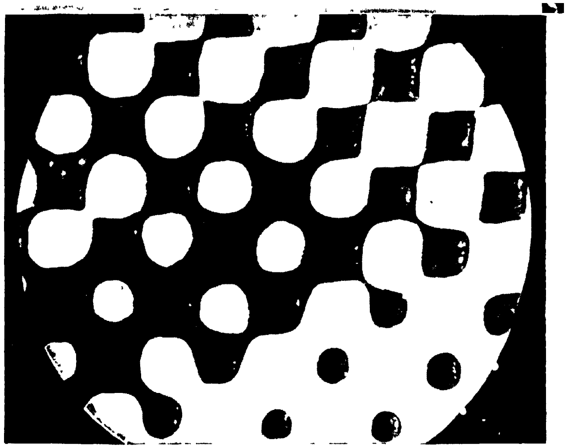
Type Printed by Lithography on a smooth cartridge paper (*magnified* 15 *times*).

The outline tends to lack that sharpness which is characteristic of letterpress printing, and there is no pressing of the ink to the edges, ink distribution being comparatively even.

Type Printed by Rotary Photogravure on a calendered paper (*magnified* 15 *times*).

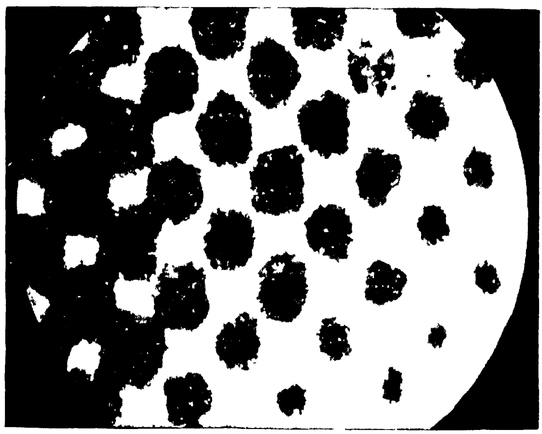
The serrated edges of the letters and the patches of ink comprising the letters, are produced by the use of the photogravure screen. The square-like patches of ink are not always so noticeable

PLATE II



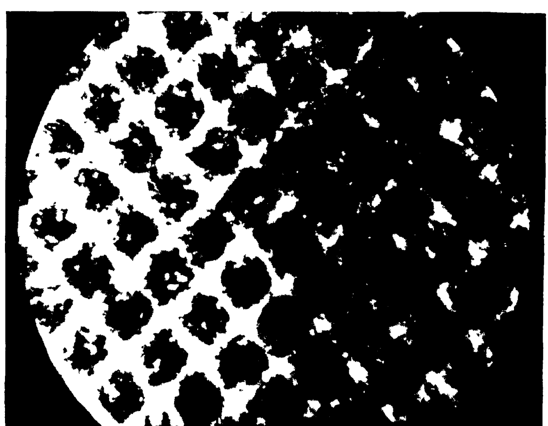
HALF-TONE PRINTED BY LETTERPRESS on art paper (*magnified* 57 *times*).

Note the clean edge to the dots obtained on this very smooth paper, and the very definite black ridge produced by the squeezing-out of the ink to the edges of the dots.



HALF-TONE PRINTED BY PHOTO-LITHO OFFSET on a smooth cartridge paper (*magnified* 57 *times*)

Dots are not so well defined as in letterpress and tend to be broken by the grain of the litho printing surface and by the fibres of the paper, giving a rather 'soft' appearance to the print.



ETCHED COPPER PLATE PRINTED BY ROTARY PHOTOGRAVURE on a smooth paper (*magnified* 57 *times*).

Shows the square dots of ink, all of the same size, obtained by the undisturbed transfer of the ink from the etched pits of the printing plate to the paper. Variations in tone are produced by different ink thicknesses.

series of pictures and text illustrating the struggle of wicked spirits and angels for the human soul at the moment of death), doubtless a best-seller in the days of the Black Death and other plagues, '*dont bien*,' as Froissart says, '*la tierce partie du monde mourût*.' These pictures usually included text, either in scrolls issuing from the mouths of the characters or placed beneath them, the whole being cut in the solid wood.

There are several existing xylographic (wood block) editions of

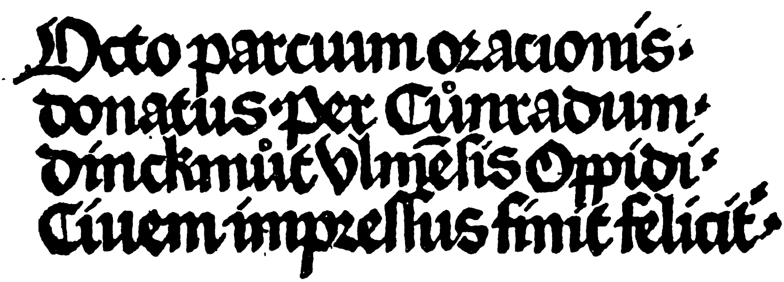


FIG. 3.
Colophon of a xylographic (wood-cut) 'Donatus' printed by Conrad Dinckmut at Ulm (*c.* 1476–77).

Aelius Donatus, a popular grammar of the period, and Fig. 3 shows the colophon (or tail-piece) of one bearing the printer's name and place of printing. Editions of Donatus are among the earliest productions of the printing press, and various fragments exist, printed from type apparently before 1458.

One of the reasons that the block book persisted was probably that it was a convenient way, in the days when type was scarce, of keeping the whole page intact for subsequent reprints; the wood block may have been more durable than the early type of soft metal, which, in any case, would have been needed for new work.

The credit of the invention of movable types is usually attributed to Johann Gutenberg of Mainz, although experiments were made some years before the appearance of the first printed book. The fragment of the *World Judgement* (*c.* 1444–47), a Calendar for the year 1448, and the Indulgence of Pope Nicholas V of 1454 antedated the Mazarin Bible (of 1282 folio pages with 42 lines to the double-column page) which was probably printed in 1455. It was printed a page at a time and had an edition of about two hundred copies, of which about thirty were printed on vellum. Gutenberg was probably responsible for its inception and preparation, and although there is no direct evidence as to the person who printed it, the latest evidence

credits Johann Fust and Peter Schoeffer with the printing. It was rubricated (that is, the initials and decorations in colour were added) by Heinrich Cremer, Vicar of St. Stephen's Church, Mainz, who completed the work on 14 August 1456.

Amid the considerable literature which discusses the invention of printing in Europe and the rival claims of Coster and Gutenberg, the facts surrounding it are apt to be overlooked. Stimulated by the invention of paper-making and the rise of the craft guilds (which were gradually superseding the monasteries and universities in calligraphy, illumination, and ancillary crafts), a growing demand for books opened up a field for some quicker and cheaper method of production. In highly commercialized Southern Germany, any paying proposition would command respect and the necessary capital for its exploitation. Gutenberg grasped this opportunity and endeavoured to co-ordinate the results of a number of previous experiments and to perfect the process of printing from movable metal types. He invented an adjustable mould from which accurate types could be cast from separate matrices (struck from properly cut punches), types that would fit it accurately and stand in line when they were composed. He also found a suitable metal alloy. He adapted the wine (or similar) press to make the impression, and found a suitable ink. It cannot be said that Gutenberg invented *ab initio* any of these things, but the evidence indicates that he brought all the factors together and made letterpress printing practicable.

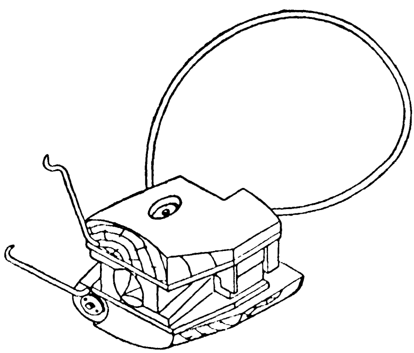


FIG. 4.
Hand Mould.

None of Gutenberg's printing is impressive, but the success of his invention is attested by the fact that there has been no major improvement in the principle of the adjustable mould and that there was little change in the method of printing up to the beginning of the nineteenth century. In less than fifty years after the invention of printing from movable types, forty thousand different editions, numbering twenty million copies, had been printed.

Gutenberg's invention, the adjustable type mould, was, with

slight modifications, in universal use until the advent of the mechanical composing and casting machine. The early typefounder's mould was probably made of brass; Joseph Moxon's moulds (*c.* 1680) were made of iron. Later moulds were made of hardened steel, ground true, of two parts screwed firmly together. The upper end of a hand mould (Fig. 4) has a seating for the matrix (which is a die of a letter). The mould, when joined, is immovable in the direction that decides the depth from head to foot of the type (the 'body'), but can be adjusted readily in the direction that decides its width. The principle is illustrated in Fig. 5.

Later moulds were made to be used with a piston or plunger which, working in the molten metal by the revolutions of a crank, forced the metal into the mould. The first attempt at mass production was the invention of Nicholson (1790) which aimed at casting several types at a time by feeding the metal by a common groove at the top of an ordinary mould. Berté's patent (1806) had a 'vessel' with apertures in the side, and the casting was effected by applying moulds to the apertures. Binny of Philadelphia (1811) attached a spring lever to the mould which considerably increased production by a quick return opening movement. Other inventions include those of Didot (1819) for multiple casting, Thomson (1831) who proposed to cast a cake of metal with types protruding and to cut it up into single types, and Bessemer (1838) whose 'self-acting' machine cast and finished type without manual labour.

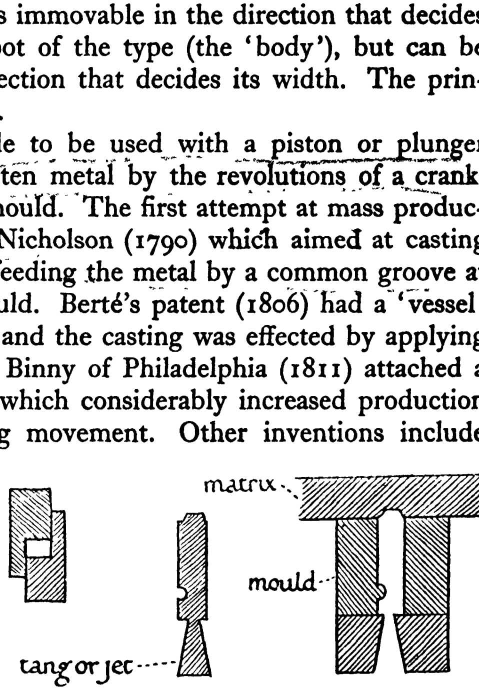


FIG. 5.
The principle of a type mould; a type cast with its tang or jet; showing how the type is formed in the mould.

About 1834 David Bruce invented a hand-force pump for filling the mould which eased casting, increased output, and improved the quality of the type. The machine and its improved form (1843) was used successfully for several years.

Later patents included the pumping system and were of three kinds: the pivotal caster (Fig. 6) in which the action of the machine rocked so that the mould was moved to and from the nozzle of the metal pot in conjunction with movements for opening and closing the mould and for tilting the matrix away from the face of the type for ejection; the rapid typecasting machine in which the hot nozzle

was held against a cold mould with a water-cooling system; and the multiple mould system already noticed.

To understand the purpose of the earlier machines for composing types, it should be remembered that the process of composing type involves the following operations: casting the type, composing or assembling the letters and spaces, 'justifying' or spacing the lines to an even width, and distributing the types after printing, or remelting it.

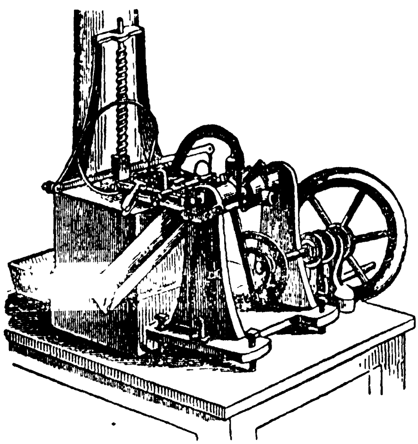


FIG. 6.
Pivotal type-caster.

The first machines (Fig. 7) for composing type mechanically used types already cast, and involved the principle of stacking the types in columns and releasing them down a chute, by means of a keyboard, for subsequent justification by hand (Church, 1822; Young & Delcambre, 1840; Hattersley, 1853; Mackie, 1867; etc.).

Later machines performed two or three of the operations of composing, not always the same ones (casting and composing, composing and distributing, composing and justifying, and so on in other combinations), and finally machines were invented that performed them all, by means of matrices, except distribution of the type, which was remelted.

Various means were used in early machines for justifying the type lines to an even length: by the use of spring spaces; by progressively inserting very thin spaces; by a group of several spaces arranged as a slug of graduated thicknesses, nicked nearly through between them, which was adjusted to the appropriate thickness and the rest of the slug broken off; by using spaces larger than necessary and passing the line through a justifier which reduced the spaces, by milling to the required thickness, according to the indications of a 'measurer'; and by the use of soft metal spaces and squeezing the line to the correct length.

In early machines types were distributed by means of a keyboard, by nicks on the body of the types, and other means, but the advantage of melting the types after use and recasting them again was soon recognized as the best method of disposing of used type. This

was the method advocated by Dr. Church, the inventor of the first composing machine, who rightly claimed that it avoided both the cost of distribution and the use of worn types.

All the operations of casting, composing, justifying, and distribution by melting were achieved when Ottmar Merganthaler invented the Linotype (1886), which assembles matrices from which are cast solid lines of type that may be used for printing direct and melted

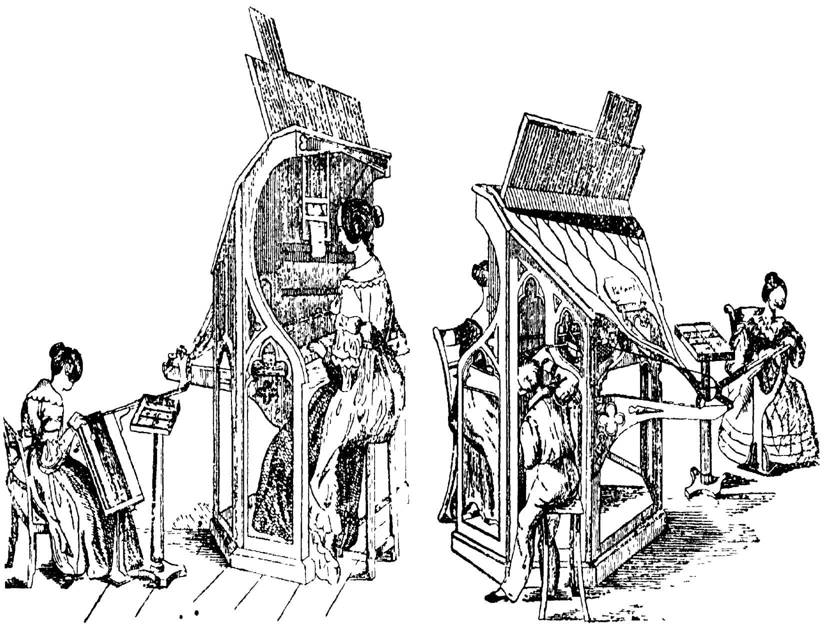


FIG. 7.
Young & Delcambre's type-setting machine, 1840.

after use. The Monotype, invented by Tolbert Lanston and commercialized about 1898, which casts and composes separate type from matrices, achieved the same ends with separate type.

Printed illustration was revolutionized by the invention of photography, and printed illustrations to-day are dependent on photographic methods for line and half-tone relief blocks in letterpress, and for printing surfaces in lithography and photogravure.

The experiments of J. N. Niepce, Daguerre, and Fox Talbot, who had endeavoured to produce various kinds of printing plates by lithographic, intaglio, and photographic methods, led to a method of producing zinc plates by etching in 1854. Other experiments to

break up the continuous tones of a photographic image into minute dots by means of a regular pattern in which the dots would give gradations from high lights to deepest shadows were made by Carleman and Stephen Horgan about 1870. Horgan produced the first relief half-tone in 1880 for the *New York Daily Graphic.* In 1881 Meisenbach made a photographic positive, brought it into contact with a pattern of transparent lines, and exposed both to metal. He used a single-line screen and made two exposures, one at 45 degrees from the other. The Max Levy cross-line screen was a further improvement on this method.

The first printing presses were adapted wine or linen presses made mainly of wood (Fig. 8) with a vertical screw for raising and lowering the platen or surface which gave the impression.

In the early sixteenth century a copper screw was introduced and the press improved by the use of a sliding bed, the tympan, and the frisket (*see* Chapter VIII).

In 1620 Blaeu improved the sliding bed mechanism by means of a crank and strap and used an iron lever instead of a screw.

The all-iron press of Lord Stanhope (1798) had a larger platen and used a screw and a system of levers to obtain impression.

The hand-press consists of a wooden or iron framework, enclosing a bed upon which the forme is laid, and a means for running the bed under a platen. The platen gives pressure and is controlled by the impression handle, rounce, or winch. The principle of leverage differs according to the type of press. At the end of the bed is a hinged iron frame called the tympan, which is covered with parchment sheets. Between these, sheets of paper are placed to vary the pressure. The paper to be printed is attached to the tympan by pins and positioned by points. To protect the paper from ink on other parts of the forme, a frisket is used. This consists of a light frame which is hinged to the end of the tympan and folded down over the paper between the tympan and the forme. The frisket is covered with a sheet of paper in which holes are cut corresponding to the printing or raised parts of the forme. Before the introduction of the inking roller at the beginning of the nineteenth century, inking was effected by means of balls (Fig. 8) or circular pads provided with a handle. The ink was spread on a stone and taken up by the balls, which were used in pairs, and dabbed on the type.

George Clymer's Columbian Press (Philadelphia, 1816) also used a combination of levers, and his press and Cope's Albion Press (1830), which applied the impression by causing an inclined bar

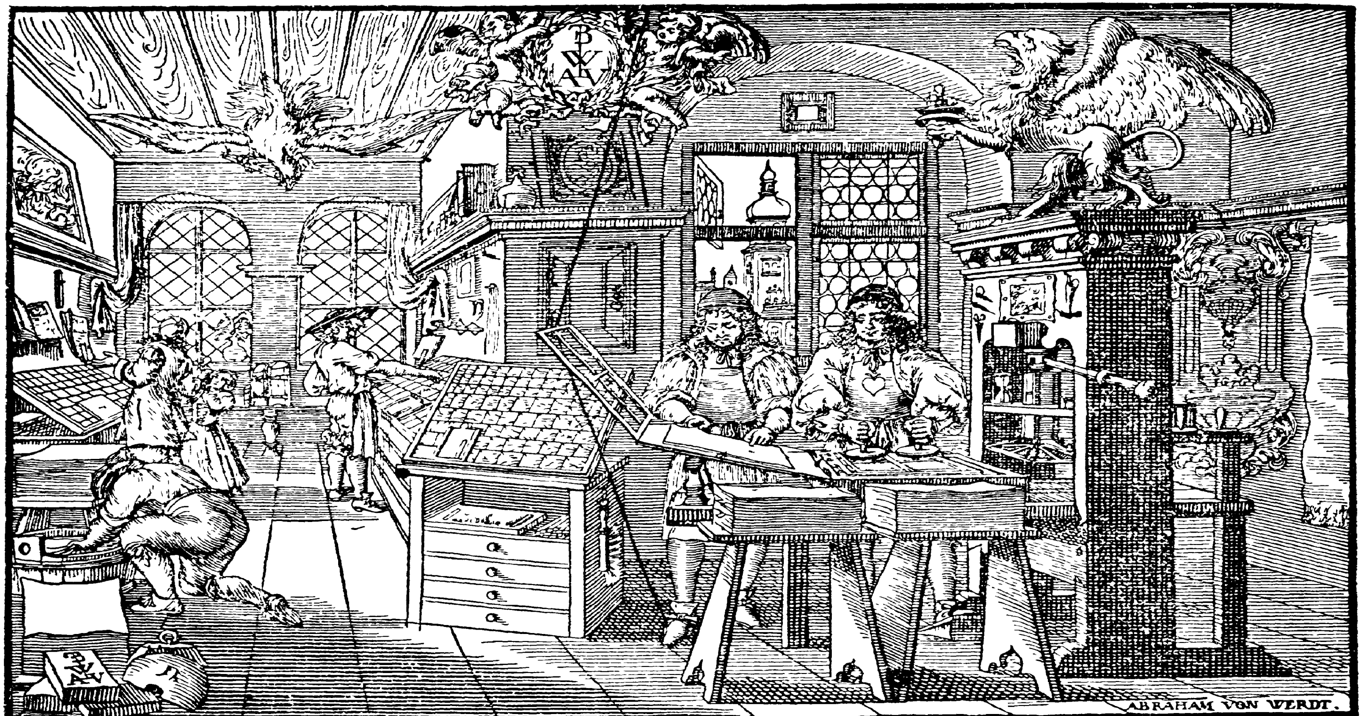


FIG. 8.

Engraving by Abraham von Werdt (*fl.* 1640–80), Nuremberg, showing a hand press in operation. One man is inking the forme with the ink balls and the other is laying the sheet in position. On the left of the picture a compositor is seen setting type.

of steel to become perpendicular in the direct line of pressure, were the principal hand-presses used before the use of mechanical power.

The platen machine, which is similar in principle to the hand-press (in which the printing surface and the platen are both flat), was invented by G. P. Gordon (1862), and was followed by Cropper's 'Minerva' about 1867. Its purpose was to supply a speedier means of printing small sheets or cards, and it was at first worked by a treadle.

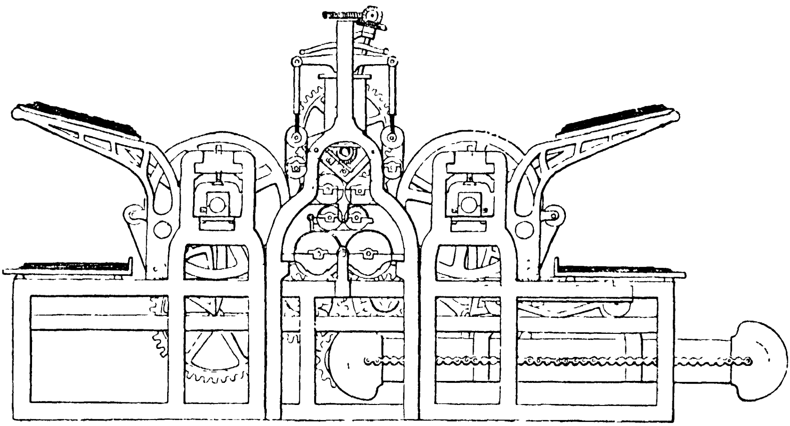


FIG. 9.
Friedrich König's cylinder press, 1814 (from Goebel's *Friedrich König*, 1883).

The first cylinder machine was an adaptation of the calico printing machine of 1750 and was patented by Nicholson in 1790. His invention was to substitute cylindrical pressure for the platen pressure, and his patent foreshadowed the chief essentials in modern machines: the reciprocating type-bed, inking by means of an ink duct and rollers, the return of the printing surface without touching the impression cylinder, grippers for holding the sheet during printing. Two methods of printing were suggested: from a flat printing surface, and by means of a cylindrical printing surface of types (scraped so that they could be fixed on to the cylinder), or a stereotype.

The experiments of Friedrich König from 1803 to 1814 gave us the first steam cylinder press (Fig. 9). He followed it in the same year with a machine of two cylinders which printed both sides of the paper in one operation, and, with J. Walter of *The Times*, a double-

cylinder machine printing two copies on one side at 1800 per hour, fed at both ends, and inked by a vertical cylinder with a hole at the bottom fitted with an air-tight piston which forced the ink on to two rollers and fed other rollers.

In 1815 Cowper curved stereotyped plates and affixed them to cylinders for printing a continuous roll or web. In partnership with Applegarth, he also built (1827) a four-cylinder machine for *The Times* with four feeding boards with four takers off which printed both sides of the paper at a speed of 5000 per hour; and (1848) an eight-cylinder press, the first rotary machine, which could print 10,000 copies of the four-page *Times* an hour. This machine had a vertical cylinder, 5½ feet in diameter, consisting of a number of planes each of column width. The main cylinder was surrounded by eight impression cylinders to each of which the sheets were fed. Two such machines were used by *The Times* from 1848 to 1868.

In 1857 an American, Col. R. M. Hoe, the pioneer of rotary presses, brought out a machine in which the types were attached to a horizontal cylinder in cast-iron beds, and which included a device for laying the printed sheets in piles.

The Walter Rotary of 1866 was the first machine to print both sides of the paper from the roll from curved stereotyped plates. Two cylinders carried the plates (each cast from a page of type), and the two impression cylinders were covered with a felt blanket. The paper was unwound from a continuous roll, several miles long, damped, passed between the pairs of printing and impression cylinders in turn, then to the cutting cylinders which cut it into complete newspapers. A mechanism for folding was added to this press in 1885, and the press in this form was used at *The Times* until 1895. Further developments of the rotary press are noticed in Chapter VIII.

The inking balls of the early printer were later replaced by a composition of glue and treacle or molasses in a melted state which was poured into canvas and shaped into balls. The development of the power press was largely aided by the introduction of the composition roller which, at first, also consisted of glue and treacle poured over canvas. It was developed by Harrild, who devised a means of casting rollers, first in split moulds, and later in cylindrical moulds which he supplied to König. The glue and treacle roller was very sensitive to atmospheric changes, and a master printer often wrapped his roller in a blanket and put it in his bed to keep it from deteriorating!

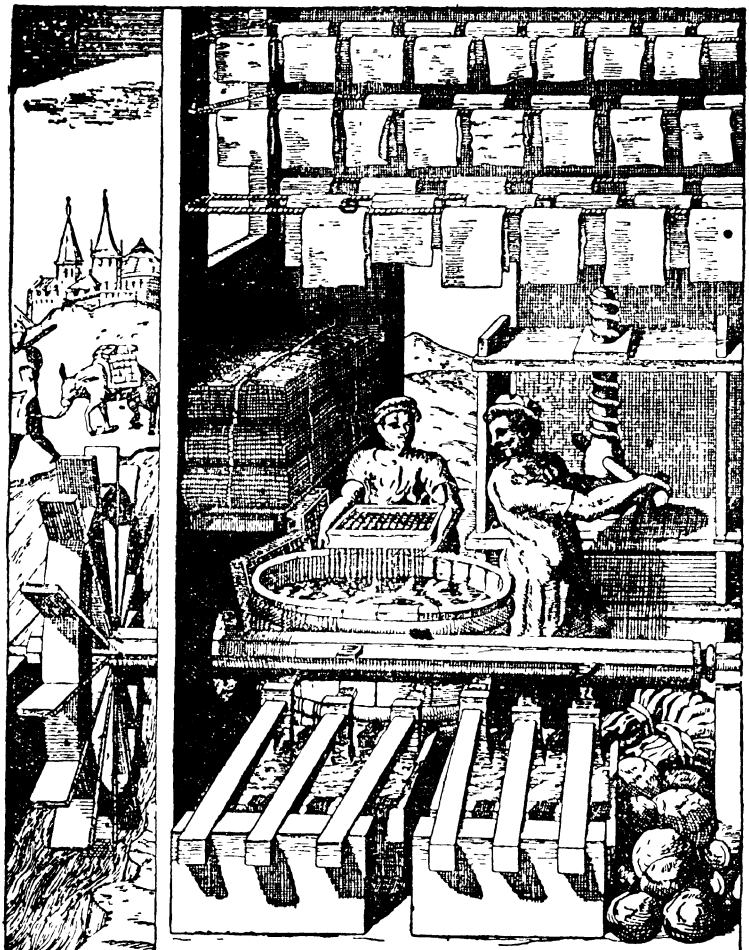


Fig. 10.
A paper mill, 1662.

Paper was brought to Europe from the East, through Bagdad and Samarkand, to Spain in the eleventh century, and thence to Italy, France, and the Netherlands. The first mill was erected in Germany in 1336, and Wynkyn de Worde (1496) mentions John Tate, 'which late hath in Englond doo make this paper thynne,' who erected the Sele Mill at Stevenage in Hertfordshire.

Until the eighteenth century paper was made by hand. Rag (cotton or linen) only was used. It was wetted and squeezed into balls (Fig. 10) and left to ferment for about six weeks, during which time it was moistened and turned. Prior to the twelfth century pestles and mortars were used for hand beating. Later the rags were beaten with stamping rods (Fig. 10), consisting of long wooden bars with a series of nails on them, worked by wooden teeth on a cog, which were raised and dropped with force into an iron or brass-lined trough or pan containing the rags and water. The pans had three stampers, and a stream of water washed away the dirt which escaped through a horsehair mesh. After pulping, sheets were made in a frame with a reticulated base which released the water and allowed a sheet to form.

About 1720 the hollander or beating engine was invented by the Dutch. It consisted of an oval-shaped trough in which a wooden revolving cylinder with steel knives worked against a bed-plate of knives. In 1798 Nicolas Louis Robert invented a machine for one of the Didots for making paper in 12–15 metre lengths. Didot came to England, and with the Fourdriniers and Bryan Donkin made the first English paper-making machine in 1803, which made about six miles of paper a day by running wet pulp on to a moving endless belt of wire so that the water drained away and left the fibres on the wire.

Six years later Dickinson (the founder of the present firm) invented a cylinder machine and, in 1821, drying cylinders were added to the Fourdrinier machine. Dickinson's machine consisted of a hollow metal cylinder covered with wire which was immersed in and rotated with the pulp. The water drained from the pulp, which remained to be carried round, lifted off, dried, and made into reels.

At the beginning of the eighteenth century rollers for glazing were introduced, and later in the century chlorine, soda, and other bleaching agents were employed. Resin was introduced for sizing paper in 1807, mechanical wood pulp in 1840, esparto grass in 1860, and aniline dyes in 1861.

CHAPTER III

THE DEVELOPMENT OF TYPE DESIGN

'PRINTING,' says Giambattista Bodoni, in the preface to his type-specimen book, the *Manuale Tipografico* of 1818, 'is the final outcome of man's most beautiful, ingenious, and useful invention, that, I mean, of writing. . . .' Calligraphy is, of course, not the only craft that has influenced the form of the printed letter, and even the earliest type letters are not derived wholly from written forms but also from a parallel tradition of letters cut in stone and metal. Nevertheless, the early printer's aim was to produce a printed book which resembled the hand-written book as closely as possible—the form of letter used in the first books almost invariably follows the contemporary manuscript letter of its place of origin.

The invention of printing did not, then, produce a radical change in the style of letters because the early printer regarded printing as an imitative *evolution* rather than as a new process requiring its appropriate forms. This desire to imitate the manuscript book may have been the reason for the absence of details regarding the production of the first printed books, as their printers had no reputation to maintain as calligraphers. Four or five years later we find Gutenberg using a grandiloquent colophon in which he boasts, rather than apologizes, that the book 'was produced without reed, stylus, or quill, but by the marvellous design, proportion, and adjustment of punches and matrices (*mira patronum formarumque concordia proportione et modulo*).'

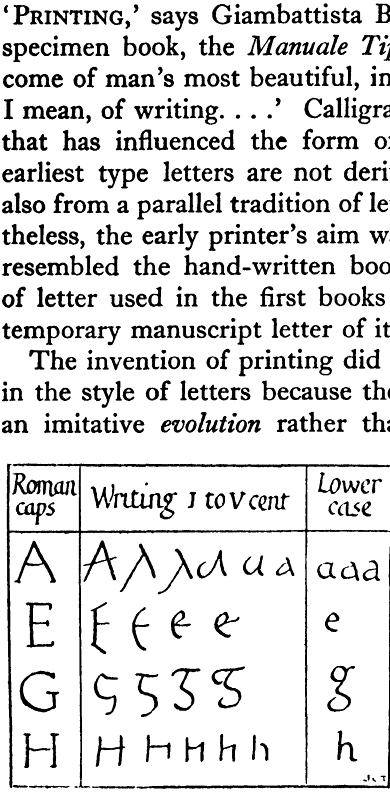


FIG. 11.
Showing how the small letters (minuscules or lower-case) developed from the capital forms.

All our printed letters are derived from the capital letters used by the Romans—the only alphabet that they used. The small letters (a, b, c, d, etc.) were evolved from these capitals, acceleration in execution changing the form by relaxing the discipline, for flexibility is the inevitable concomitant of script. Figs. 11 and 12 show some of

these changes, which were, of course, influenced by materials and tools. In almost every period there are roughly three kinds of letters used: an inscriptional form (for stone-cut or other permanent purpose), a formal (for books and records), and an informal, cursive, or running hand (for everyday use). In Egypt these are seen in the stone-cut

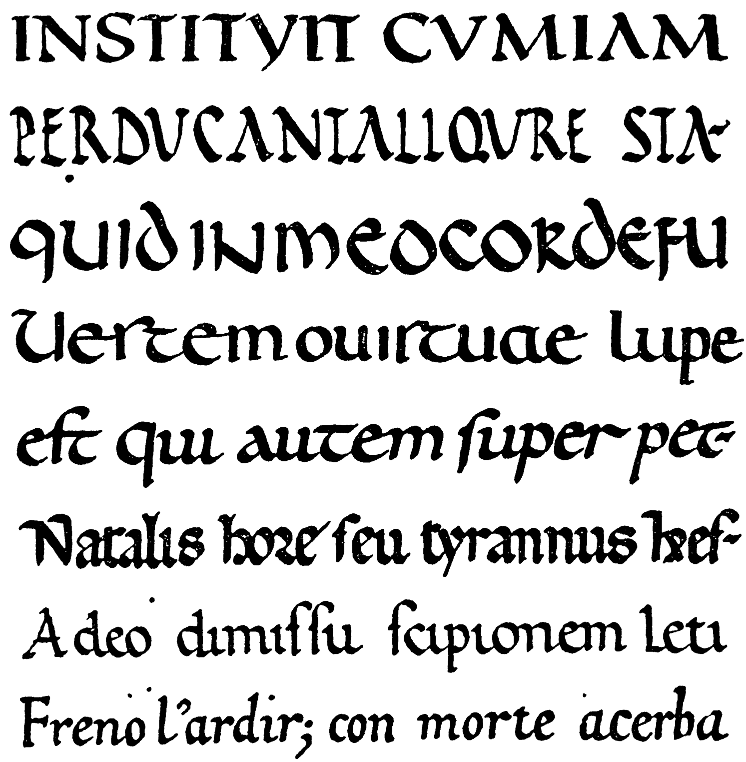


FIG. 12.

Stages in the development and evolution of small (minuscules or lower-case) letters from roman capitals: square capitals (fourth to eighth centuries); rustic capitals (fifth century); uncials (fifth century); half-uncials (eighth and ninth centuries); caroline minuscules (ninth century), gothic or black letter (twelfth century); humanistic or *littera umanistica* (fifteenth century); chancery or *littera corsiva* (fifteenth century). The last two examples are the originals of our roman and italic printed type small letters.

hieroglyphic, the hieratic book-hand, and the popular writing aptly called demotic. At the time when printing was invented there were formal and informal black letters; to-day there is the stone-cut or painted inscriptional capital, the printed letter, and the devitalized scribble called handwriting.

Our printed capital letters are derived from Roman epigraphic

letter forms through the formalized versions of Pacioli, Da Vinci, Dürer, Tory, and others, and the small letters (called *lower-case* by the printer) are derived from a ninth-century model. This model (Fig. 12) was evolved from half-uncial forms (fifth to sixth century) by the scribes, under a handwriting reform instituted by Charlemagne (Charles the Great), in which the forms were purified of their cursive elements. The caroline minuscule (or small letter) was written with a quill-pen with the end cut obliquely.

By compression, in order to save space, this letter developed angularity and blackness, and resulted in what we call gothic or black letter. This tendency may have been influenced by the rise of gothic architecture and architectonic forms of carved and inscriptional letters that were considered to be in sympathetic harmony with the pointed arch (*cf.* the elongated forms used with Perpendicular English Gothic). A new feature was introduced into this black letter by the fracturing of the stroke and the *fraktur* form was evolved, a letter form still widely used in Germany.

When printing was invented at Mainz, there were roughly four forms of this gothic letter: a *textura*, *lettre de forme*, or printed gothic (used for bibles and service books, *vide* the 42-line and 36-line bibles, the Mainz *Psalter* printed by Fust and Schoeffer in three colours in 1457, and the first dated English printing—the Indulgence of 1476 printed by Caxton at Westminster); a round gothic or *lettre de somme* (used for printing classical and scholastic works, *vide* Gutenberg's *Catholicon* and the work of Günther Zainer at Augsburg and Ulrich Zel); a *rotunda* or round text, *vide* the work of Erhard Ratdolt and Nicolas Jenson; and a *lettre bâtarde* or cursive gothic, used for printing works in the vernacular, and in which Caxton's earliest books are printed.

In the fifteenth century the literary movement known as the Renaissance, in its zeal for classical learning, went to those texts which had been written in the caroline minuscule, and the scribes, in copying the matter of the volumes, also copied this lighter, finer, and more open style of writing and regularized its inconsistencies. This revived letter (the *scrittura umanistica* or writing of the humanists), was at first confined to Italy, and the name *gothic* (or barbarous) was applied contemptuously by the humanist scribes to the black letter. The formal and informal (or roman and italic, as the printer would say) versions of this letter, shown in Fig. 12, are the basis of our present-day roman and italic printed letters.

The first roman types were used by Adolf Rusch at Strasbourg in

1464, but their development is best seen in the work of German printers in Italy. Sweynheim and Pannartz, who set up a press in the Benedictine monastery at Subiaco, near Rome, in 1465, used a letter transitional between gothic and roman. Under the influence of the *scrittura umanistica* and the objection of the Italian scholars to gothic forms, more roman-looking types (Fig. 13) were used by the

monſtra haberentur.Deinde aliquãto poſt cum theolog
quorundam philoſophorum ſentẽtias digeſſiſſ&:oppoſ
ait.Hoc loco dicit aliquis.Credat ergo cęlum & terram d
alios:infra alios.Ego feram aut Platonem:aut peripateti
alter deum fecit ſine corpore:alter ſine animo.Et ad hoc
tandem inquit: Veriora uidentur Titi Tatii aut Romul
ſumma:Cloatinam Titus Tatius dedicauit deam:Picum
Hoſtilius Pauorem atq; Pallorem:teterrimos hominum

Lo Helephante fa ſuono in boccha circa lenari ſimile allo ſ
ſuori ſuono ſimile a quello delle trombe.Solamente ebuoi
mine che emaſchi.In tutti glaltri e loppoſito:& tra glhuon
hãno piu graue boce che le femine.Del fanciullo che naſce i
e tutto fuori.Non parla ſenon dopo lanno:Ma elfigluolo
di ſei meſi:elquale prodigio ſignifico laruina di tutto quel
minciono a parlare preſto penono piu a andare. Lauoce
ci anni in la & nellauecchiaia ſaſſongla.Ne e alchuno altro
ſo ſimuti.Sono preterea molte coſe degne di riferire della u

FIG. 13.
(*Above*) The type of Giovanni e Vindolino da Spira, Venice, 1469, and (*below*) that of Nicolas Jenson, Venice, 1470.

Da Spira brothers (Venice, 1469), and notably Nicolas Jenson (Venice, 1470), whose types a contemporary ascribed 'rather to divine inspiration than human wit.' Jenson's letters are regarded as the first pure roman types and have been revived in our own day, notably by William Morris (Golden type), the type used by the Doves Press, the Cloister of the American Typefounders, and Mr. Bruce Rogers' individualistic interpretation, Centaur.

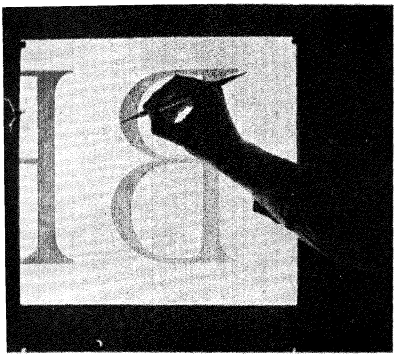
Jenson's letter was copied all over Italy soon after its appearance,

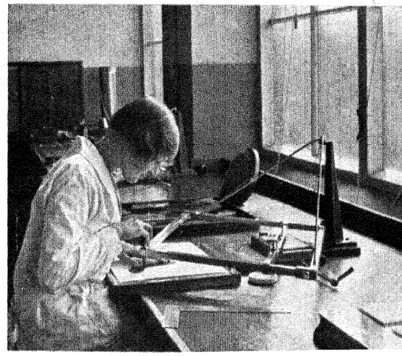
and twenty-five years passed before any new design appeared. Aldus Manutius founded his press at Venice in 1495. His roman type was first used in a small tract, the 'De Ætna' of Pietro Bembo, in 1495. This is the design on which all subsequent *old-face* types are based, and it differs from Jenson's letter in several important details. The Aldine design has greater contrast between thick and thin strokes, the serifs (the small finishing strokes at the ends of letters) are finer, the letters are not so wide, the capitals follow more closely the stone-cut tradition, and the eyestroke to the e is horizontal. This design was later used by Aldus in the most celebrated of all early illustrated books, the *Hypnerotomachia Polifili* (1499), which contains more than 500 woodcuts of great charm and delicacy. Revivals of both these designs are shown in the next chapter. Aldus's reputation as a publisher has tended to obscure his merit as a printer, and though his presswork is often poor, the importance of the Aldine types has been under-rated and inadequately acknowledged.

Now at last the printing letter was able to hold its own: type could look like type—if it were legible—and not like an imitated manuscript letter. The manuscript book tradition, however, kept the early printers from innovation in the matter of margins and details of format, and the printer still depended on the illuminator for much of the decoration in books.

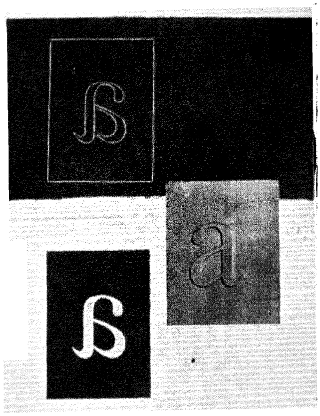
In 1498 Urceus Codrus wrote to Aldus complaining that his edition of Aristotle in five volumes cost as much as ten of the largest and best manuscript books, which implies that the printed book could command good prices as against its rival. This complaint may have induced Aldus to issue his series of pocket editions of classic works in 1501. For these volumes he used the first printed version of what we now call *italic* types because they conserved space. This letter was already in existence as a hand-written letter, and had been adopted officially by the Papal Chancery in 1450 for writing briefs, and was called for that reason *cancelleresca corsiva.* It was not, as is often asserted, copied from Petrarch's handwriting. Later italics were cut by Ludovico Arrighi and Antonio Blado, and it is from these, rather than those of Aldus, that our present *old-face* forms are derived. In their purest form they are seen in the modern revivals used with the Bembo and Centaur types.

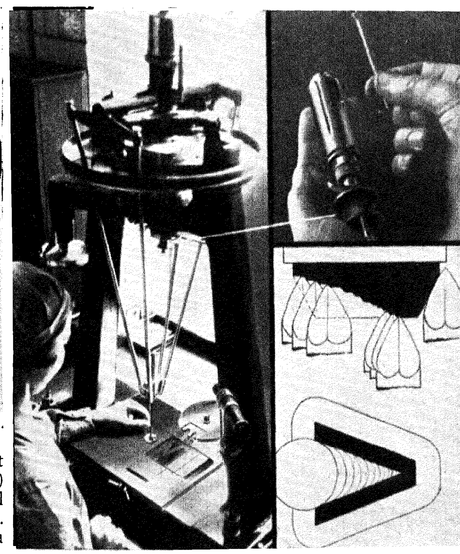
Printing was brought to England by William Caxton, whose first work was an indulgence of 1476. He learnt the art in Cologne and Bruges in partnership with Colard Mansion, with whom he printed his first book, the first book in English. Caxton imported all his



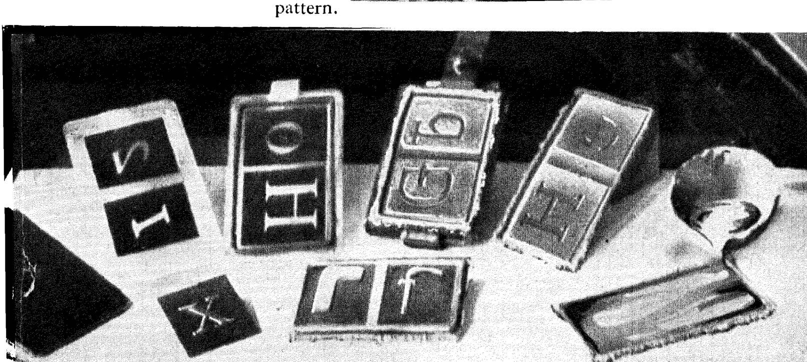


Tracing the projectoscoped copy. Cutting the wax core.



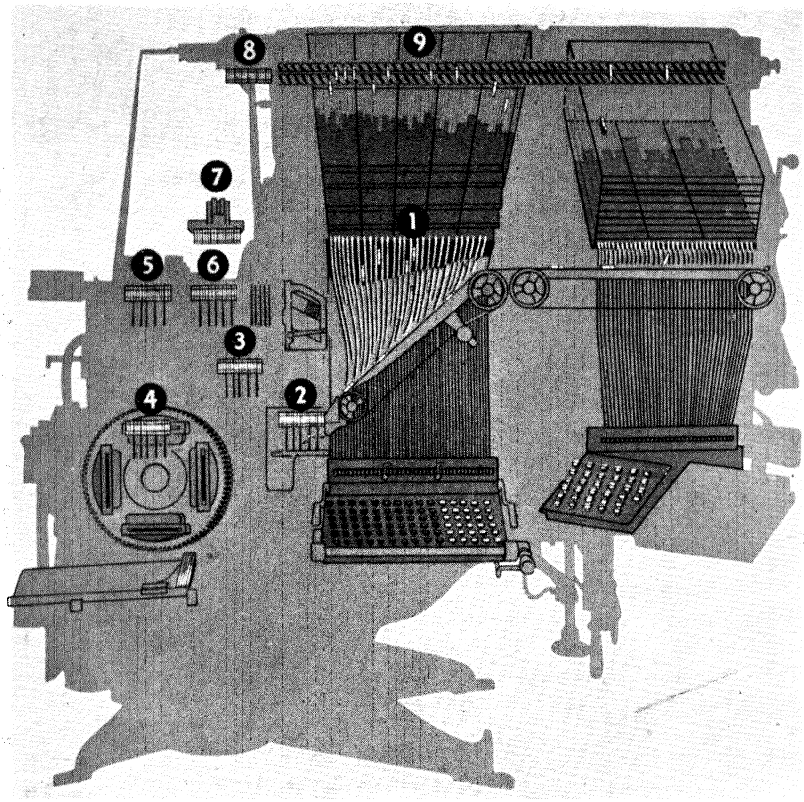


(*Above*) Wax plate with and without core, and completed pattern. (*Right*) Punch-cutting machine with cutting tool and diagram showing series of cuts. (*Below*) Stages in the making of a pattern.



[*Monotype Corporation Limited.*]

PLATE IV



Diagrammatic view of a Linotype, showing the path taken through the machine by the freely circulating matrices.

(1) Matrices leaving the magazine in the order required by the operator, having been released by the depression of key buttons.
(2) Matrices and spacebands being assembled in line.
(3) Completely assembled line of matrices and spacebands being transferred to the first elevator, after being released from the assembler by the operator (who now proceeds to set the next line).
(4) Line of matrices and spacebands in front of the mould for justification and casting.
(5) The line after casting being carried upward for its transfer to the second elevator.
(6) The line is transferred to the second elevator ready for rising to the distributor mechanism. At this point the spacebands are separated from the matrices and transferred to the spaceband box ready for use again.
(7) The line of matrices (now without spacebands) being lifted to the level of the distributor bar suspended over the magazine.
(8) Matrices being fed, one by one, so as to be engaged by rotating screws, which propel them along the distributor bar.
(9) Matrices passing along the distributor bar until released by their combination of teeth, which causes them to fall into their original channels ready to be assembled for casting other lines of matrices and spacebands.

types from abroad, but his standards were much below those of the Continent. He printed about a hundred works, books that would command a ready sale: tales of chivalry for the upper classes, service books for the clergy, sermons for preachers.

The first independent typefounder was Claude Garamond, who cut the types for most of the leading printers. His clear, open, free and spirited types, elegant and precise in line, were sold to Robert

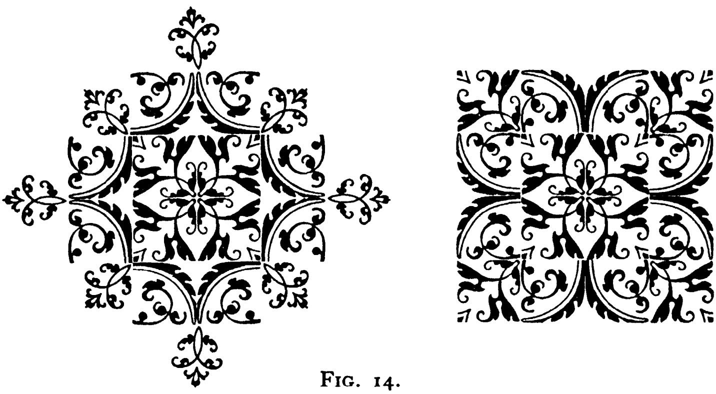


FIG. 14.

Fleurons or printers' flowers. Originally derived from the arabesque decorations used by bookbinders. Popularized in type form by Robert Granjon (mid-sixteenth century) and widely used in the following century. Revived in the twentieth century. They consist of a number of units which may be combined into an infinite number of patterns for use as borders, chapter headings and other purposes.

Granjon, le Bé, and Plantin, and eventually his designs became standard all over Europe in the sixteenth century and were introduced to England by John Daye.*

At Lyons about this time good work was done by Jean de Tournes, who used the arabesque compositions of Bernard Salomon. Robert Granjon, who was related to Salomon, translated these designs into type forms and stimulated the use of printers' flowers or *fleurons* (Fig. 14).

Plantin of Antwerp exploited these *fleurons* and continued a fashion which is frequently seen in English books of the Elizabethan period. In spite of his notable *Polyglot Bible* (1569–72) and his competent use of copper-plate engravings (notably in title pages), Plantin's fame

* It should be mentioned here that the modern recuttings of types called *Garamond* are actually copies of those cut by Jean Jannon in 1620. Jannon's types eventually came into the possession of the French National Printing Office. In the nineteenth century they were revived and mistakenly attributed to Garamond. When the design was later copied by the trade typefounders these versions were called *Garamond*.

is due rather to his achievements as a publisher. His work was not superior to his contemporary townsmen, Jean Bellère, Jean Loe, and Stelsius.

The sixteenth century saw the rise in the Netherlands of the Elzevir dynasty, who first began to publish at Leyden in 1580 and who won fame by the publication of neat editions of classics at low price in a small format with engraved title pages. Christoffel van Dijck of Amsterdam (whose types, says Moxon—one of the most famous English writers on printing—possessed 'all the accomplishments

> This is the Fell type *and its italic.* These types were presented by Dr. John Fell to the Oxford University Press during the seventeenth century and are still in use.

FIG. 15.

that can render *Letter* regular and beautiful') cut types for the Elzevirs and other Amsterdam printers which were contemporary interpretations of Garamond's letter, and which became the model upon which the Englishman William Caslon in the eighteenth century cut his types.

During the century, however, English printing was relatively unimportant, and most of the type used between 1500 and 1630 was imported. English bibles were printed at Paris, Thomas More had his *Utopia* printed at Basle, and Knox was printed at Geneva. English presses tended to confine themselves to printing books in English and more scholarly works were imported. In the middle of the sixteenth century no printing press was allowed except in London and the two universities; in 1637 the Court of Star Chamber limited the number of typefounders to four, and although the restrictions were removed from 1640 to 1662, they were again enforced at the end of the century.

The equipment of the Oxford University Press during this century was enriched by types (Fig. 15) imported from Holland and presented by Dr. John Fell between 1667 and 1672. The University Press began its own foundry at this time. The founts are still in use at Oxford, and examples of their distinguished use are common (*vide* certain Oxford editions of Stevenson's *Treasure Island*, *Kidnapped*, and *Catriona*).

For the most part, English seventeenth-century books were printed in Dutch types, a taste fostered by the Court, and which

continued later because of the stifling effect of state legislation. Reed, the historian of the English typefoundries, says that there was probably more Dutch than English type used between 1700 and 1720.

This lamentable state of affairs was remedied by William Caslon, the greatest of English typefounders, who began to cut types under the patronage of Bowyer and Watts who printed for Jacob Tonson.

Caslon issued his first specimen in 1734. His letter was directly founded on Dutch models, the similarity being so close that he was, until recently, credited with the types used in Selden's *Works* (1726) which are actually those of van Dijck and Johannes Kannewet. For this reason it is not easy to explain the uniqueness of Caslon's letters, but their fame and use has remained to this day, for, in spite of their individual imperfections, in mass their effect is agreeable, and they have become so naturalized as to be thought wholly English. In the light, however, of the revival of more distinguished types of the past, Caslon's importance rests rather on the fact that he was the first competent English typefounder.

In the middle of the seventeenth century a new design appeared on the Continent which broke the Aldine-Garamond-Caslon tradition and which was developed during the eighteenth century.

This departure in design originated in the following way. In 1640 Cardinal Richelieu established the Imprimerie Royale (later Imprimerie Nationale) and, soon after, Louis XIV, agreed to a suggestion that the office should have a new type letter for its exclusive use. A committee was appointed, and their report recommended a letter based on a mathematical basis of a background of 2304 squares. The design was executed by the punch-cutter Grandjean de Fouchy, who interpreted the designs in his own way. This letter (Fig. 16) has horizontal unbracketed serifs which continue on both sides of the heads of b, d, h, and similar letters, and the l has a small flick in the middle. The horizontal serif had been used by writing masters (*vide* Tagliente's *littera tonda*, 1520, and Fanti, 1530), but this was its first appearance in a printed letter. This new letter (the *romain du roi Louis XIV*) was first used for a volume of commemorative medals (1694–1702). Its success was immediate, and, in spite of its protection by royal decree, was quickly copied.

The chief advantage of the new design was its condensation and sharpness of cut, which was in harmony with the copper engravings used with it. For the first time the capitals were made as high as the

dans l'Isle de Saint-Amand, & battit encore huit
Doüay. Aprés quoy il ſe campa entre cette Ville
terreur dans tout le Pays, qu'il fourragea juſques a
Enfin il marcha vers Condé, & ayant pris d'abor
cauld, il fit faire un logement ſur la contreſcarp
meſme, 25 d'Aouſt, le Gouverneur ſe rendit à la ſ
Comte demeura aux environs de cette Place juſ
bre, & cette entrepriſe n'ayant eſté faite que pou
ou pour les attirer à un combat, il abandonna C
Campagne, & prit Maubeuge en revenant.

C'eſt le ſujet de cette Médaille. On y voit Pa
preſt à lancer; le fleuve de l'Eſcauld effrayé s'ap
Légende, HISPANIS TRANS SCALDIM PU
ſignifie, *les Eſpagnols défaits & pouſſez au-delà de*
CONDATUM ET MALBODIUM CAPTA. M
Condé & de Maubeuge. 1649.

FIG. 16.
Romain du roi. Imprimerie Royale, Paris, 1702.

ascending strokes of the small letters, and the forms, assumed an engraved form and thus abandoned the calligraphic tradition. From this time types began to show sharper contrast in stroke, horizontal serifs, and narrower widths. Grandjean's successor at the Imprimerie Royale, Louis Luce, cut a condensed letter (the *poétique*) which had oblique serifs and was particularly adaptable for setting the long line of the French alexandrine. His 1740 miniature specimen showed a new kind of rococo decoration.

Pierre Simon Fournier also cut types in the new manner, slightly narrowing the proportions and modifying the serifs. He began his foundry in 1736 and contributed much to the perfection of printing. His contributions to printing literature (the *Manuel Typographique* and various essays) are classics of the craft. His *Manuel* (in two volumes, 1764–68) deals with the manufacture of type, shows specimens of his types and his method of standardization of type sizes. His

CASLON OLD FACE

This is the roman letter cut by William Caslon in 1742 and is one of the most celebrated of all the old-face types. *The italic has decorative capitals called 'swash.' AEGMNT*

BASKERVILLE

The type of John Baskerville may be called *transitional*; it foreshadows the 'modern' cut and it eliminates certain inconsistencies of *the older italics without undue rigidity,*

FIG. 17.
Examples of modern recuttings of Caslon and Baskerville types.

method was revised by François Ambroise Didot, the first of a dynasty, who cut types with exaggerated contrasting strokes which give the effect of glacial rigidity of line, and which, mistakenly, emulated classic austerity. Fournier cut variations of roman, first in different size bodies of the same design (to avoid interlinear spacing), then heavier versions with shorter descending letters, condensed, and so on.

In the meantime, the good work begun in England by William Caslon had been continued by a Birmingham writing-master and tombstone cutter, for John Baskerville's letter (1754) was based on his own calligraphic and epigraphic practice, and exhibits much roundness and fineness of cut which the hot-pressing of his printed sheets well expressed.

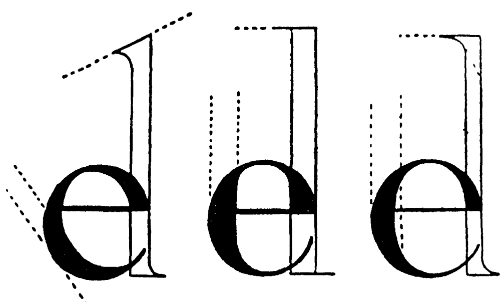


FIG. 18.

Comparison of Old Style and Modern type forms: Old Style with biased stress and oblique serifs; Modern with vertical stress and horizontal serifs; Modern with vertical stress less pronounced and with the horizontal serifs bracketed.

He made his own apparatus, ink, presses, and casting moulds. As each sheet left the press it was placed between hot plates which removed the indentation of the types and gave a slight gloss to the sheet. His types are a compromise between *old-face* and *modern*; although the stress is vertical, the serifs are slightly oblique. His revived letter enjoys deservedly a wide use in our own times, in spite of the weakness of the italic. In *modern* types there is a sharper contrast between thick and thin strokes; they have thin refined horizontal serifs, and a perpendicular stress. Fig. 18 compares *old style* and *modern* type designs. The sharper contrast of strokes can only be expressed on papers with a smooth surface, and this was Baskerville's chief innovation in printing technique.

Baskerville's design was copied by his immediate successors, Alexander Wilson (who cut types for the Foulis brothers, printers to Glasgow University) and the Fry foundry at Bristol. The Fontana type based on Wilson's letter is used by Collins of Glasgow; one of Fry's types is still marketed by Stephenson, Blake & Co., Ltd., and the Linotype Georgian reflects the same spirit.

In 1788 appeared the first English *modern*, the type cut by Richard

Austin for John Bell, the publisher and newspaper owner. This letter is sharper and has less colour than that of Baskerville; Austin's later types were more distinctly *modern*.

In 1800 type designs followed the *modern* style, and were thickened and emboldened by such founders as Robert Thorne and William Thorowgood for use in display work. In 1802 Bell's *Weekly Messenger* appeared in a new *modern* face which became the standard style for newspapers until the re-stylings of the 1930's. The fashion for this style of letter gradually led to a decline in type design and printing, apparently because the principle of its design lent itself to greater degradation and grotesqueness. Versions of the design now current are Scotch (cut about 1809 by Wilson), Walbaum (cut by Justus Erich Walbaum of Goslar and Weimar), and Bodoni.

Giambattista Bodoni of Parma (1740–1813) in his early work emulated Fournier, but later eschewed all decoration and used type designs of *modern* cut for which he claimed the merits of *regolarita, nettezza e forbitura, buon gusto,* and *grazia.* His types well suited his typographical style which used wide margins and generous interlinear spacing. His achievements are best studied in his monumental *Manuale Tipografico* (Fig. 19) of 1818. He was printer to the Duke of Parma and his press was, in effect, a private press: 'je veux que de magnifique,' he says, 'et je ne travaille pas pour le vulgaire des lecteurs.' He did not contemn the masses—he never considered them at all, any more than he considered expense or practical convenience. His work was therefore outside the main stream of typographic development and bore little practical fruit. Bodoni produced princely volumes for princes and aristocrats, was praised by all for his typography, and deplored by many for his textual errors.

The fine tradition of such printers as Bensley and Bulmer lost its impetus after the first quarter of the nineteenth century, and it was not until twenty years or so later that William Pickering the publisher and Whittingham the printer established a new standard (Fig. 20) based on the revival of type designs of the past, a revival stimulated by the romantic movement in literature and the arts. They began by using Caslon's types in small amounts for title pages about 1840, and in 1845 published *Lady Willoughby's Diary*, printed throughout in Caslon's types. A similar revival took place in France under the leadership of Louis Perrin of Lyons.

In 1852 Miller & Richard issued a modernized *old style*, a regularized version of Caslon's letter, but larger on the type body, the

Quousque tan-
dem abutêre, Ca-
tilina, patientiâ

Quousque tan-
dẽ abutêre, Ca-
tilina, patientiâ

Quousque tan-
dem abutêre,
Catilina, pati-

FIG. 19.
Roman types cut by Giambattista Bodoni, Parma, 1818.
(From the *Manuale Tipografico.*)

purpose of which was to 'avoid the objectionable characteristics of the mediæval [*sic*] letters.' These and other versions helped the reaction against the Bell-Martin-Bodoni school. Henry Daniel at

THE PHILOSOPHY OF
THE BEAUTIFUL

FROM THE
FRENCH OF VICTOR COUSIN

TRANSLATED
WITH NOTES AND AN INTRODUCTION
BY JESSE CATO DANIEL
CHESHUNT COLLEGE

LONDON
WILLIAM PICKERING
1848

FIG. 20.

Oxford (1877) revived the use of the Fell types after 150 years of disuse, and there was a distinguished use of *old-style* by Selwyn Image and Herbert Horne in *The Country Guild Hobby Horse* (1888). Horne also designed the Montallegro (1905) for the distinguished American printer Daniel Berkeley Updike (at the Merrymount

Press, Boston, U.S.A.), the Florence type (1909) for Chatto and Windus, and the Riccardi type (1909) for the Medici Society.

The private press movement, under the inspiration of William Morris, encouraged revivals by the use of founts based on the types of Jenson, such as the Golden type (used at his own Kelmscott Press) and the Doves type (used by Emery Walker and Cobden-Sanderson), and from this time the history of type design is largely concerned, at least in book types, with revivals.

SYNOPSIS OF ROMAN TYPES AND THEIR REVIVALS

Venetian:	1470 Nicolas Jenson	Venezia (1900), Centaur (1914)
Old Face:	1495 Aldus Manutius	Bembo (1929)
	1499 Aldus Manutius	Poliphilus (1923)
	1532 Robert Estienne	Estienne (1930)
	1550 Claude Garamond	Granjon (1924)
	1561 Christopher Plantin	Plantin (1914)
	1615 Jean Jannon	Garamond (1917)
	1650 Christoffel van Dijck	Van Dijck (1935)
	1726 William Caslon	Caslon (1844)
	1745 Pierre Simon Fournier	Fournier (1925)
	1757 John Baskerville	Baskerville (1923)
Modern:	1765 Giambattista Bodoni	Bodoni (1920)
	1787 John Bell	Bell (1931)
	1789 William Bulmer	Bulmer (1939)
	1812 Miller & Richard	Scotch
	1815 Justus Erich Walbaum	Walbaum (1933)
Old Style:	1850 Miller & Richard	Old Style
	1911 Gerard Meynell	Imprint
	1932 'The Times'	Times Roman
	1932 Eric Gill	Perpetua

CHAPTER IV

TRANSITION

MECHANICAL invention and the substitution of power other than human physical effort as the working energy of production had a profound effect on printing in the nineteenth century.

The gas engine had been introduced about 1875; in 1897 the *Daily Mail* imported electric motors from America for their rotary machines, and in the same year Messrs. Hazell, Watson & Viney used electricity to drive their flat-bed cylinder printing machines. By 1924 electricity was in general use throughout the printing trade.

These advances naturally brought about a vital change in the relationship of human labour to processes and products—and the death of handicraft as it had been understood. The old handicraftsman began to be superseded by the application of *power* instead of human energy, *precision mechanism* took the place of skill, and a small band of *technicians and specialists* of craft knowledge.

The power press (1811 onwards) and the rotary newspaper press multiplied the production of the hand-press many times. The increase of smaller jobbing work to meet the needs of the new industrial age was stimulated by the introduction of small platen machines, and printed matter up to quarto sizes of paper was able to be printed more quickly and at lower cost.* Their general use dates back to the 1860's. The same principle applied to other forms of general printing, such as posters, which began to be printed by steam-power-driven cylinder machines.

Fourdrinier's papermaking machine (1804) and its later improvements made large quantities of paper available from new substances, such as esparto grass, and with the discovery of soda wood pulp (1854) and sulphite paper pulp (1882), the large circulation daily newspaper became practicable. Circulation was further increased by casting curved stereotyped plates which could be fitted to the cylinders of rotary printing presses and printed from a continuous reel of paper.

The inventions of Niepce (1834), Fox Talbot (1852), Ives (1878), Horgan (1880), and Max Levy (1891) led to photo-mechanical line

* Cards which had cost 15*s.* per 1000 were printed at a third of the price. Handbills printed on a hand-press had cost 5*s.* per 1000; printed on a platen, they were charged at 8*s.* 6*d.* per 10,000. The comparative cheapness of platen printing also encouraged the growth of colour-printing now that new colours were available from coal-tar products.

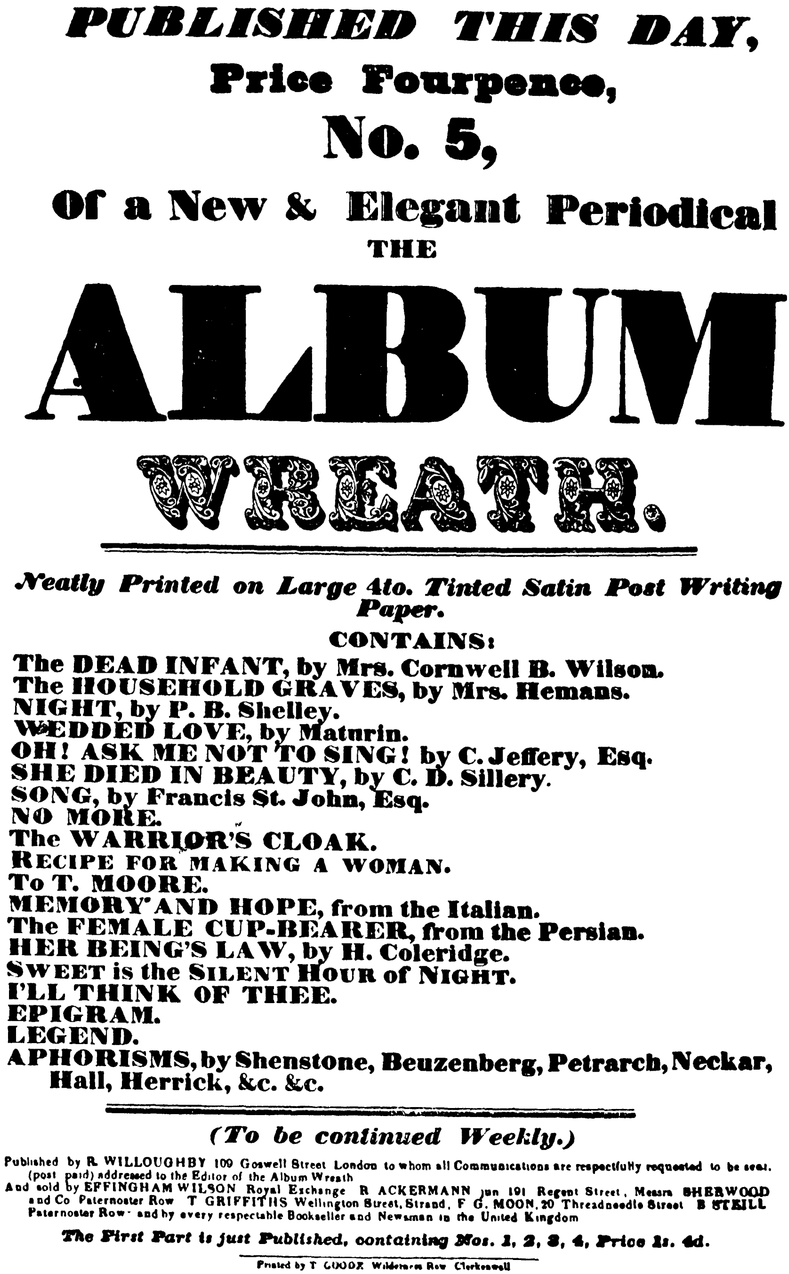
and half-tone engraving, and superseded the autographic methods of wood and metal engraving. The tones of the photograph could now be simulated both in monotone and multi-colour. The development of rotary photogravure from hand gravure gave us the large edition picture paper, such as *The London Illustrated News*, *Picture Post*, and the film magazines.

Benton's invention of the pantographic punch-cutting machine in 1885 opened the way for the type-casting and type-setting machine (Linotype 1885, Monotype 1887), which used matrices composed or directed by means of a keyboard instead of types composed by hand from cases. These machines not only performed the work of several hand-compositors, but provided new type for every job and the type was remelted after use, thus relieving the compositor of the drudgery of putting the types back into cases for re-setting.

The nineteenth century saw the rise of that kind of printing called 'jobbing' which is, in the main, distinguished by the use of varying sizes and styles of type design to ensure prominence and contrast. 'A job,' says Savage in his *Dictionary* (1841), 'is anything, which printed, does not exceed a sheet . . . cards, shop bills, bills for articles stolen or lost, playbills, lottery bills, large posting bills. . . .' The bill (Fig. 21) is a later version of the written or engraved tradesman's card, public notice, or inscription. Dickens's monthly issues contained advertisements similar in style to bills, and the illustrated magazines and newspapers followed the same style.

The first type designs which were issued to fill the growing demand for jobbing work were fattened or emboldened versions of existing designs, such as bold *moderns* and egyptians (later called antiques), which were introduced to give emphasis when used with the prevailing roman types which were thin and colourless. These designs were followed by worse travesties (Fig. 22) of the roman letter, 'monstrosities,' as Hansard in 1820 called them. Such letter designs reflected the confusion into which the new industrial development had thrown other arts and crafts, where haphazard improvization took the place of design, or where imperfect maladjustments of the styles of other historic periods were employed in the effort to create forms for new kinds of manufactured goods.

Sanserif (letters without finishing strokes) designs were at first regarded as egyptian types with the serifs removed and called 'Grotesque,' just as a man without feet might be considered grotesque. In the early versions of display types there was also an analogy (more fancied than real) between letter designs and the classic orders of


PUBLISHED THIS DAY,

Price Fourpence,

No. 5,

Of a New & Elegant Periodical

THE

ALBUM

WREATH.

Neatly Printed on Large 4to. Tinted Satin Post Writing Paper.

CONTAINS:

The DEAD INFANT, by Mrs. Cornwell B. Wilson.
The HOUSEHOLD GRAVES, by Mrs. Hemans.
NIGHT, by P. B. Shelley.
WEDDED LOVE, by Maturin.
OH! ASK ME NOT TO SING! by C. Jeffery, Esq.
SHE DIED IN BEAUTY, by C. D. Sillery.
SONG, by Francis St. John, Esq.
NO MORE.
The WARRIOR'S CLOAK.
RECIPE FOR MAKING A WOMAN.
To T. MOORE.
MEMORY AND HOPE, from the Italian.
The FEMALE CUP-BEARER, from the Persian.
HER BEING'S LAW, by H. Coleridge.
SWEET is the SILENT HOUR of NIGHT.
I'LL THINK OF THEE.
EPIGRAM.
LEGEND.
APHORISMS, by Shenstone, Beuzenberg, Petrarch, Neckar, Hall, Herrick, &c. &c.

(To be continued Weekly.)

Published by R. WILLOUGHBY 109 Goswell Street London to whom all Communications are respectfully requested to be sent. (post paid) addressed to the Editor of the Album Wreath
And sold by EFFINGHAM WILSON Royal Exchange R ACKERMANN jun 191 Regent Street, Messrs SHERWOOD and Co Paternoster Row T GRIFFITHS Wellington Street, Strand, F G. MOON, 20 Threadneedle Street B STEILL Paternoster Row - and by every respectable Bookseller and Newsman in the United Kingdom

The First Part is just Published, containing Nos. 1, 2, 3, 4, Price 1s. 4d.

Printed by T GOODE Wilderness Row Clerkenwell

FIG. 21.

Poster, 1834, exhibiting fattened Modern types as introduced by Robert Thorne and William Thorowgood.

AN EARLY ANTIQUE
probably cut before 1820
No 1.

CAST BY GEORGE BRUCE
as a substitute for the bold-face
No 2

THE DORIC ANTIQUE
has features of roman
No. 3.

THE IONIC ANTIQUE
has large face, open counters
No 4.

FRY AND SON

AMSTERDAMWIEN

WESTMORE

FIG. 22.
Early 'jobbing' type faces: 1–4 varieties of antique; egyptian (1823), grotesque (1834); tuscan (1830).

architecture. Thus the Doric order (without a plinth) gave a name to a type without serifs; egyptian (also called Ionic and Antique) was associated with the Ionic order and darkness; the roman Ionic or Etruscan order gave a name to the Tuscan type; Doric type was also imagined to be analogous to early Greek stone-cut letters.

In this exploitation of typographic material there were several influences at work to regenerate the design of printing and printed letters from the haphazard and often grotesque style of the early bills. The private press movement (William Morris at the Kelmscott Press, Cobden-Sanderson and Emery Walker at the Doves Press,

Cheltenham Old Style

Cheltenham Old Style Italic

Cheltenham Wide

Cheltenham Bold Outline

Cheltenham Bold

Cheltenham Bold Shaded

Cheltenham Bold Italic

Cheltenham Bold Expanded

Cheltenham Bold Compressed

Cheltenham Bold Compressed Italic

Chelt. Inline Extended

Cheltenham Inline

Chelt. Inline Extra Cond.

FIG. 23.
Some of the related designs of the Cheltenham Family.

St. John Hornby at the Ashendene Press, and others) reaffirmed the fundamentals of decent book-production which had only been maintained to some slight degree since William Pickering and Charles Whittingham's revival of Caslon's Old Face in the 1850's. This revolt was carried still further by their camp followers (the Arden, Westminster, and Pelican Presses) into the wider fields of occasional printing and advertising, where a new order and decency began to prevail.

Morris's influence and teaching now seem to be reactionary because of his insistence on craft and his refusal to accept the inevitability of the mechanization of printing. His apostles, however, endeavoured to demolish the old standards and to pave the way for new ones in

spite of their condemnation of the 'commercial' half-tone, leaded type, and other things—prejudices arising from their craft standards.

The Cheltenham design (Fig. 23) which appeared at the beginning of this century, with its bold and other versions related in style and weight, coincided with other influences to purge the early bill style of its worst elements, and the practice of using related designs led to the disuse of earlier designs in the more progressive offices.

Early advertising (as we have noticed) followed bill style, but the growing rivalry between manufacturers of almost identical products led to a need for distinction in their respective announcements, and the principle of identification by distinctive trade mark and wrapper was more widely used. The printer was, unfortunately, unable to give

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PLATE V.

The pictures comprising this plate illustrate the more essential parts and the product of the Linotype composing machine:

A is a matrix from which the type is cast. It bears two characters—one roman, the other italic, either of which can be used in the setting of a line. The series of wards or notches in the V portion assist the return of the matrix to its correct channel in the magazine.

B is a spaceband. It consists of a pair of wedges, so arranged that they provide parallel outer walls at any point of expansion. A spaceband is used between words when a matrix line is being assembled, so as to spread out the line to its full measure when the slug line is being cast.

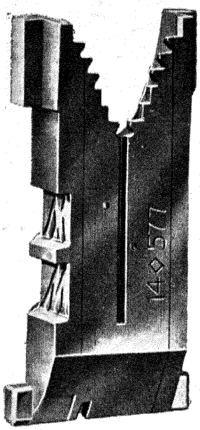
C shows an assembled line of matrices and spacebands ready for casting. Note how the italic words 'who' and 'operated' are aligned with those in roman characters, and the spacebands raised to justify the line.

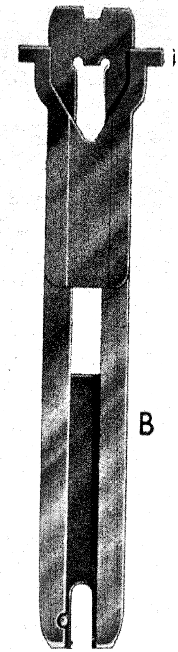
D is a sectional view of the slug casting mechanism. A line of matrices and spacebands can be seen in front of the mould orifice (which provides the body of the slug). The type metal in the crucible is a mixture of lead, antimony, and tin, and is melted by electricity, gas, or oil. After a slug has been cast, the mould in its wheel is rotated against a knife at the back to remove the gits (or surplus metal) and make it type high. The slug is then ejected from the mould and passed between two parallel knives which reduce it to its true body size. Meanwhile the matrices and spacebands are returned to their original housings ready for use again.

E shows part of the matrix distributor mechanism, whereby each line of matrices after the casting operation is separated into its units, which then travel along a ribbed bar from which they are suspended until released over their respective channels in the magazine. The movement of the matrices along the bar is effected by rotating spiral shafts (not shown) which engage with the ears or lugs in the matrices. As can be seen in the figure, the ribs on the bar are cut away at certain points; it will also be noticed that some of the teeth in the matrices are missing in a like manner. These combinations are so arranged that the matrices cannot disengage from the bar until they reach their correct positions for release nor remain on the bar after they reach them.

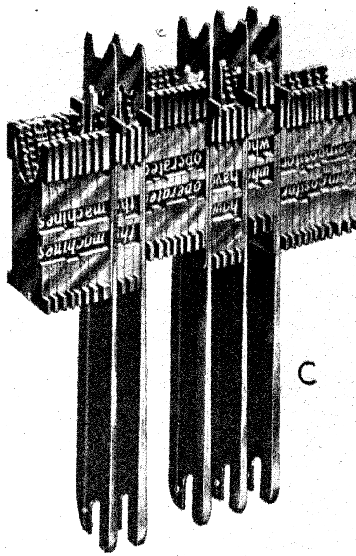
F is a typical example of the machine's product—a composite line of type. The example shown was made from a slug set in a 10 point face to a measure of 18 ems wide. The body size and length of the slug are variable to suit the printer's needs. For example, for one job he may need lines of 5½ point in 13 ems measure, and for the next job lines of 36 point type 30 ems wide

A

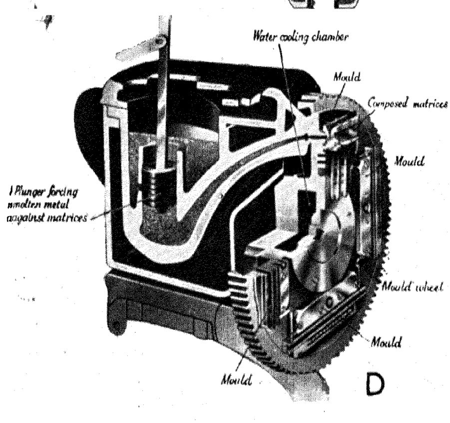




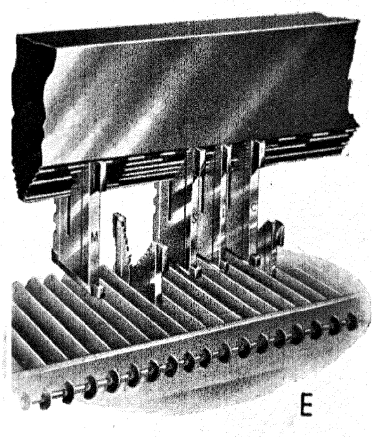
B



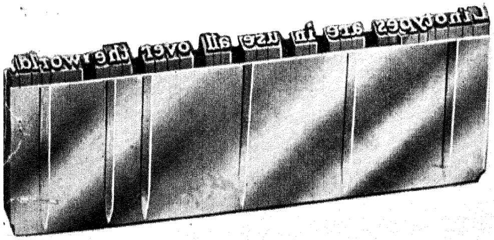
C


Water cooling chamber
Mould
Composed matrices
Mould
Plunger forcing molten metal against matrices
Mould wheel
Mould
Mould

D

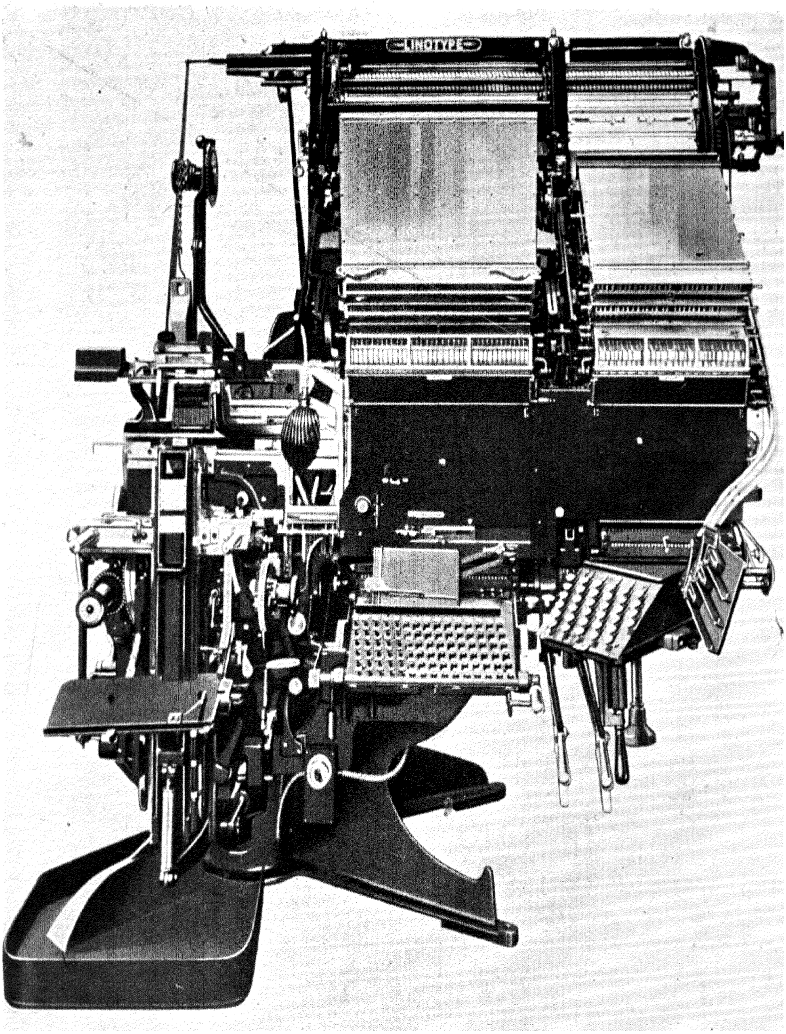


E



F

PLATE VI



This machine is known as the Linotype. It produces complete lines of set type matter in slug or bar form. It consists of a series of magazines (each containing a number of brass plates bearing type characters in intaglio), a keyboard for assembling the matrices in word and line formation, a casting mechanism for producing composite lines of type from molten metal, and a distributing arrangement for returning the matrices to their magazines ready for use again.

adequate expression to the policies of advertisers, and the task was taken out of his hands by the rising advertising agency with its specialist designers. Advertising thereupon became specialized, and the agencies began to create new forms of typographic presentation for their clients, not only in the growing national press advertising, but in advertising literature and sales-promotion matter.

These various developments brought about an entirely new state of affairs. By 1914 the printing craft was on its way to becoming an industry, a fact not yet fully realized among some sections of the trade where there is still a tendency to adhere to the craft tradition.

It may be that developments proceeding from post-war reconstruction will see the complete industrialization of the industry in all those sections which are capable of being so organized.

The fullest illustration of this transition of printing from a craft to an industry is seen in the newspaper and periodical sphere.

The modern newspaper owes its development in the first place to the abolition of the tax on newspapers. The cheapening of newsprint (by the invention of wood pulp and the improvement in papermaking machinery); the increase in literacy, the growth of the railways (which aided distribution), and the electric telegraph (which facilitated the gathering of news) were other important contributory factors.

The popular magazine came with *Tit Bits* (1880), *Answers* (1888), and *Pearson's Weekly* (1890). In 1896 the half-penny daily newspaper, the *Daily Mail*, arrived, followed by the *Daily Express* four years later. The perfection of the half-tone process led to large editions of daily picture papers, such as the *Daily Mirror*, *Daily Sketch*, and the *Daily Graphic*.

The complete mechanization of newspaper printing is exhibited in the methods of organizing and disseminating the radio-graphed, telegraphed, typed and written words of news, views, and letters from all parts of the world by means of type-setting machines, automatically moulded stereotypes, printed on rotary machines at almost incredible speed from rolls of newsprint. Each unit of the Hoe 'Super Speed' machines of *The Times*, for example, can print two sections of eight pages each in one revolution of the cylinders. Each of the nine folders is capable of producing 40,000 copies of *The Times* in one hour.

CHAPTER V

THE REPRODUCTION OF PICTURES BY NON-PHOTOGRAPHIC METHODS

Reference has been made to the early woodcuts which preceded printing from movable types and which continued to be used with it. A woodcut is a design cut in relief and in reverse on the plank surface (i.e. part of a tree sawn with the grain lengthwise) of soft woods, such as pear, apple, cherry, sycamore, beech, lime, and whitewood. A knife, with a cutting edge at an acute angle with the back of the blade, is used, and cuts are made by drawing the knife towards the body. The lines of the design are first drawn on the wood and the intervening spaces cut away. The cutter makes a block that reproduces in terms of lines. The early woodcuts were often coloured by hand, although several artists produced colour prints by cutting the main lines in one block and using other blocks, one for each tone or colour (usually tones of the same colour), a method called *chiaroscuro*, which was revived in the early nineteenth century by Savage who called it polychromatic printing.

Early woodcuts are simple and full of character, and Albrecht Dürer and Holbein exploited the method for reproducing their drawings. Dürer's work exhibits great invention in graphic power and dramatic force in grim and satiric humour. Holbein was simpler and more severe in style and without Dürer's abundance of detail. His 'Dance of Death' is a typical example of his work.

In France, at the end of the fifteenth century, fine woodcuts were used in Books of Hours at Paris as substitutes for illuminations and miniatures, by Antoine Vérard, Pigouchet, Du Pré, Kerver, Vostre, and others. At the end of the sixteenth century woodcuts were superseded by copper engravings and the art declined. In the eighteenth century the Frenchman Papillon began to use boxwood, but it was the Englishman Bewick who first began to engrave on the end-grain of boxwood (Fig. 24) and to evolve a new technique of engraving in terms of white lines. Bewick's aim was to reproduce tone, and in this he anticipated photography by rendering textures and tone relationship. His work is seen at its best in the *History of Quadrupeds* (1790) and *Birds* (1797).

A wood-engraving is a finer kind of woodcut, engraved in relief with gravers and other tools on the end-grain (i.e. part of a tree

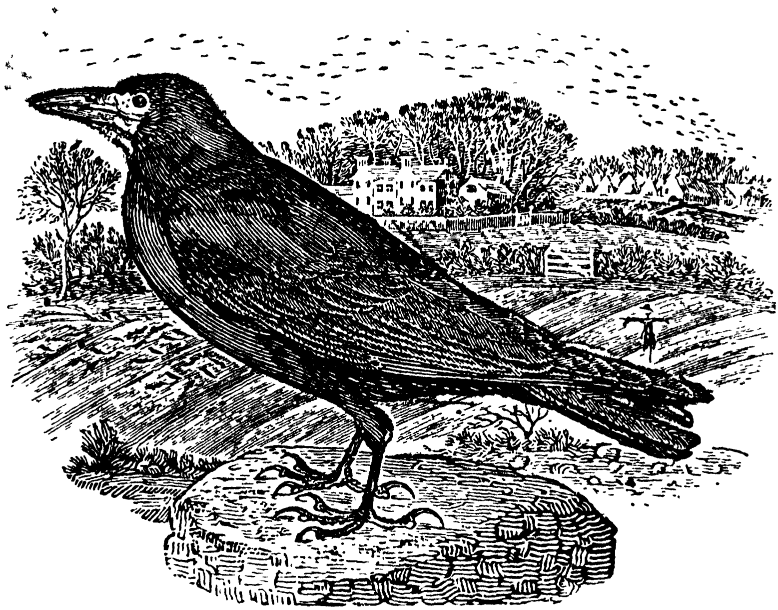


FIG. 24.
Reproduction of wood engraving by Thomas Bewick from the *History of Birds* Newcastle, 1797–1804.

sawn across the grain). Boxwood is obtainable only in small pieces, which are glued or bolted together for large blocks. The graver or burin is lozenge-shaped in section and is pushed forward, wide or narrow lines being made according to the amount of pressure exerted. The tint tool is used for making tints and shadings; the scorper is a gouge for clearing away larger areas. Various methods are used for placing the design on the surface of the wood before engraving: Chinese white coating and pencil tracing; carbon and tracing paper; black paint (each line cut is then seen plainly against this ground in direct cutting without a drawing); and photographic transferring, first used about 1870.

Bewick had few notable successors, except William Blake, Edmund Evans, and Calvert, and in the nineteenth century wood-engraving fell into the hands of professional engravers. The firms of Dalziel Brothers and Swain developed a school of facsimile engravers that reached a pitch of superb craftsmanship, and reproductive engraving was used largely in such periodicals as *The Cornhill Magazine*, *Good Words*, *Once a Week* (Fig. 25), which were illustrated by Millais, Leighton, Fred Walker, and others. *The Illustrated London News* and

The Graphic also produced wood-engraved pseudo-photographic effects, printed from wood blocks in heavy oil colours.

In large illustrations the wood was prepared by bolting several pieces together. The surface was then painted with a white ground and a pencil or wash drawing made on it. The block was then divided into its components again and given out to several workmen to engrave, the joints being first engraved. Urgent work would often

FIG. 25.

An example of commercial wood engraving by a professional engraver, after the drawing by John Tenniel. From *Once a Week*, 1859.

be taken home and brought back the next morning. The pieces were then reassembled and bolted, and the master engraver would perfect the work at the joins and smooth other parts. The work was then printed from the wood or electrotyped. There is still a good deal of commercial wood-engraving which is used for certain kinds of illustrations such as engine-turned watch-cases and fountain pens. Such work is often mechanical and lifeless.

There is a live wood-engraving school to-day which is rather an æsthetic revulsion from the photo-mechanically produced line-block than a commercial reproductive process. Fine work may be seen in the books of private presses (who usually print direct from the wood) by such engravers as Eric Gill, Clare Leighton, Agnes Miller Parker, Reynolds Stone, Gwen Raverat, Douglas Bliss, Robert Gibbings, and others whose work is published in larger editions and printed from electrotypes. In advertising, woodcut and wood-engraving *effects* have been exploited by means of scraper board, a chalk-covered card which can be covered with indian ink and scraped, and finally used as copy for a photo-mechanical line block.

Broad mass and line work is often done from linoleum (Fig. 27) and rubber, which is said to be more sympathetic to ink. It is easier to lift ink from a large area of linoleum or rubber than it is from metal, whether the medium of the pigment is oil, matt oil, or water, and the resilience of linoleum and rubber enables a wider range of paper surface to be used. The design may be placed on the linoleum in several ways or transferred on a hand-press from a copying ink tracing. The tools for cutting are cheap and cutting is much easier. For this reason—and its cheapness—it has been adopted as a practice medium for schools. Large lettering and designs in mass can be easily cut on

Fig. 26.
Wood engraving by Agnes Miller Parker from *Through the Woods.*
[*By courtesy of Victor Gollancz Ltd.*]

FIG. 27.
Linocut by Ursula Birnstingl.
[*By courtesy of the artist and The Favil Press.*]

linoleum, and much successful poster work has been executed in this medium. Fine lines are apt to break down in cutting and printing.

Rubber cuts have a canvas backing and are as easy to cut as linoleum. The cut is usually mounted on metal. Less pressure is required to print them and less ink.

Non-photographic intaglio processes include those which are etched by means of an acid and those which are engraved by means of various tools.

Etching consists of covering the surface of a copper plate with a 'ground,' a composition of various waxes, resins, and gums. The plate is then blackened by being held over lighted candles. Then with a steel needle the etcher draws through the ground to open up the surface of the copper. The edges and back of the plate are painted with a protecting varnish, and the plate is etched (eaten away) in an acid bath. When the finer lines are etched, the plate is removed and these lines are protected with varnish. The process is repeated according to the depth required in the lines making up the design or picture. Etching allows greater freedom than direct engraving, but needs to be carefully controlled. By using a soft ground on the plate, designs may be drawn on thin paper stretched over the plate, the ground being removed with the paper as it comes away. Subsequent etching then produces lines with the character of the grain of pencil or crayon.

Copper engraving (Fig. 8) was first used about 1477 but it did not come into general use until the middle of the sixteenth century. It was at first used for title pages and portraits and had the advantage that it could be corrected or altered by hammering up the back and re-engraving, a practice often employed. Many of the famous painters (Rubens, Van Dyck, Rembrandt, and Raphael) reproduced their work in this medium, and for several hundred years the greater part of book illustrations were printed from copper. Much later it found fresh scope in the printing of bank notes until steel engraving was evolved about 1800.

Copper and steel engraving is done with a graver or burin. The plates are highly polished and the slightest scratch will receive ink and so show in the resultant print. The cutting throws up a slight burr which is removed with a scraper. The plate is printed by rubbing a stiff ink all over it and working it into the incised parts. The surface is then wiped clean, leaving the ink in the incisions. A heavy, soft, dampened paper is then put against the plate and pressed in a mangle-like press with a soft packing, the ink being transferred to the paper. The plate will give up to 5000 impressions. The process is still used commercially for conventional visiting cards and sometimes for letter-headings and maps, although the latter are usually printed by the photo-litho-offset method.

Steel plate engraving is more durable than copper engraving and allows greater variety in such treatment as ruled backgrounds, clouded effects, vignettes, borders, and very fine lines. It was until recently widely used for printing postage stamps and bank notes. The cutting is done in soft steel and the plates are case-hardened to ensure long life.

Copper engraving was, at the end of the eighteenth century, overshadowed by mezzotint which was used for the reproduction of paintings by Reynolds, Gainsborough, Romney and others. In this process, a copper plate is worked to a toothed surface, varying in depth, by means of a steel rocking tool with a curved edge of sharp teeth which dig into the metal and turn up spikes. The rocker is worked over the plate until a texture is built up. The surface is then worked away with a scraper or burnisher until the recesses in the plate will just hold enough ink to give the desired effect. Printing is effected as with an etched plate, the burred teeth retaining the ink according to their treatment. The method is, in effect, a negative one as the engraver works from what would be a black background in the printing to the highlights. Turner's *Liber Studiorum* (1867–69) was illustrated by this method, in conjunction with etching.

Aquatint is an imitation of water-colour washes. The tints are obtained by etching, different parts of the plate being partially protected by a ground in the form of a grain through which the acid can bite, other parts being wholly protected by varnish during the etching. So, by a series of etchings of different depths, a series of tones is obtained in the final print. The process was first popularized by Jean Baptiste le Prince during the eighteenth century and perfected later in the century by other French artists. It was used by English artists for reproducing water-colour drawings, the colour being applied by hand.

Drypoint is a similar process to etching except that a sharply pointed steel needle or a diamond is used, which raises a burr on the metal. The burr in the subsequent printing gives drypoint its particular character. The process is sometimes used with etching and aquatint. The delicate burr flattens down in printing and its effect is rarely seen to advantage after the first fifty copies.

Stencilling is an old method of reproducing a design and is to-day effectively used in certain kinds of show-card and other printing. In principle it consists of cutting holes in some kind of card or sheet and brushing ink through the holes. Its simplest form is seen in stencils for marking packing cases.

Stencils may be cut from card or thin sheets of metal or celluloid. The drawing or tracing for each stencil is pasted to the material used and cut on plate glass, a separate stencil being used for each colour, although in certain cases two stencils may be required for the same colour where crossed lines or similar enclosed areas are needed.

Selectasine and other silk-screen or stencil processes use the principle of the typewriter stencil. The stencil consists of a wax-impregnated fabric and the design of the work (usually in two or more colours) is made by removing parts of the wax from the fabric. To print from it the stencil is laid on a sheet of paper and a thick opaque flat colour is squeezed through the interstices of the fabric on to the paper. A separate stencil is required for each colour. The advantage lies in the fact that the mesh of silk, organdie, or metal cloth eliminates the need for connecting ties for holding enclosed centres together. A 'film' of lacquer on thin, transparent (glacine) paper is also used. The design is cut on the film and then attached to the tightly stretched silk screen, the paper being stripped off. Photographic transparencies are now employed for transferring fine line and continuous tone pictures of fairly coarse screens.

Lithography was invented by Alois Senefelder about 1798 and

was exploited by Engelmann, Guérin, and Isabey, in France. Its first use in England was in Smith's *Antiquities of Westminster* (1807). Senefelder's prints in colour used flat tints and, although the standard was greatly improved by French and English workers, the process tended to decline as the work was reproduced on the stone by trade lithographers and not by the artists themselves. Etching, woodcutting or wood-engraving, and photographic processes also replaced lithography for periodical illustration. At the end of the century, however, there was a gradual revival, culminating in the Champs de Mars (Paris) and Düsseldorf Exhibitions of 1895. With the advent of the rotary lithographic machine (1886), photo-lithography, and offset (1905), the use of the lithographic principle was widely extended.

Lithography is a planographic printing process and is based on the strong adhesion of grease to calcareous stone, the facility of calcareous stone to absorb water, and the affinity of one greasy substance for another and their mutual antipathy to water.

The main source of lithographic stone, which is a soft porous yellow limestone consisting mainly of calcium carbonate of lime, is the Solnhöfen district of Bavaria. The stones are from two to eight inches thick (according to their area) and vary in size up to 60×40 inches.

The stones are made perfectly level by a stone-planing machine to obtain uniform thickness and further prepared for use with a levigator, a circular disc of perforated iron with a handle, running freely on an eccentric spindle. For chalk work this instrument is swung around over the surface by hand or power, using a coarse abrasive and water to grain the surface. Old work is also removed in the same way. Mechanical devices are also used for preparing the stone. For graining metal plates an open box is used with glass or porcelain marbles which roll on the surface and control the graining.

After cleaning and wiping the surface is ready to receive the design, which may be drawn direct by hand with litho chalk or ink compounded with grease, soap, shellac, and lamp-black. The process is very flexible and drawing may be done with pencil or pen, spattered with a brush, dabbed, transferred through fabric, air-brushed, or laid down from transfers by pressure. The method used for placing the design on the stone affects the subsequent treatment. The following description applies to a design in litho chalk or crayon.

The grease in the crayon is later changed in composition and rendered insoluble in water, being left with an affinity for greasy compounds. The stone readily absorbs water, but water would be

repelled by the parts of the stone which have been treated with the crayon. The affinity of the stone for grease is removed by means of a solution of gum arabic, containing a percentage of acid. This acid unites with the calcium in the stone and gives the surface of the stone a greater affinity for water and no affinity for grease. When dry, the superfluous gum arabic is washed away and the surface is unaffected. The surface is then rolled with a greasy ink over the damp stone, the ink being repelled by the dampened parts but attracted to the greasy parts which form the design. The stone is then dusted with powdered resin, which adheres to the inked parts and forms a surface resistant to acid. An application of a solution of nitric gives a slight "etching" to the bare stone (leaving the protected design unaffected). This is a chemical etch and does not alter the thickness of the stone materially; it allows richer inking.

The stone is then desensitized by another application of gum arabic (which does not affect the design) and dried. Turpentine is then washed over the stone to remove the black pigment of the original crayon, and the design is made more secure by washing with a solution of asphaltum. Another washing removes the gum arabic, and the stone is ready for the printing machine.

When several colours are used a key drawing is made as a guide for each colour, and a tracing made for each colour on transfers for separate transfer to the respective stones.

The lithographic press for proofing has a fixed leather-covered box-wood or steel scraper under which the stone is carried. A greased tympan is hinged to the bed on the outer surface to overcome the resistance of the scraper as the stone passes under it.

A lithographic printing machine has a travelling bed on which the stone is laid and fixed. The bed is raised or lowered to bring the surface of the stone to working level, according to its thickness. The machine has two sets of rollers, one to supply ink and one to dampen the stone. There is a heavy cylinder to apply pressure and an iron slab for supplying the ink to the rollers, and a second cylinder to remove and deliver the printed sheets.

Nowadays most lithography is printed from aluminium or zinc plates, particularly when the work is printed on rotary machines, as the plates can be fixed around the cylinder of the machine, a practice also used in photo-litho-offset, which is described later.

CHAPTER VI

TYPE AND TYPE CASTING

TYPE has three dimensions: *height-to-paper* (·918 in.), which is the same for every type and printing block; *body*, the depth from head to foot, which is now measured in terms of the typographical point (·01383 in. or about $\frac{1}{72}$ in.); and *set*, its lateral measurement. Other terms used to describe the parts of a type are shown in Fig. 28. The *face* is the printing surface, the *body* is the bulk of the type, the *shoulder* is the platform from which the face arises, the *counter* is the inside shape, the *pin-mark* is the indentation made as the type is ejected from the mould when it is cast, the *nick* serves to guide the typesetter (or compositor) for position when assembling types in lines and to identify the collection (fount) to which it belongs. Nicks vary in position and in number on the bodies of types. The *groove* separates and forms the *feet* upon which the type stands.

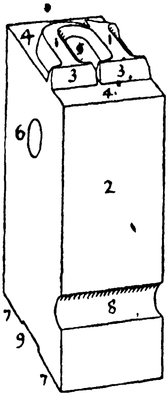


FIG. 28.
Parts of type: (1) face; (2) body or shank; (3) bevel; (4) shoulder; (5) counter; (6) pin-mark, (7) feet; (8) nick; (9) groove.

Types are made of an alloy of lead, tin, antimony, and sometimes a very small percentage of copper, particularly for casting script types. Larger types are hollowed or recessed, and types with a face of more than one inch in depth are made of hard wood.

A fount of type (Fig. 29) is an assortment of any one style and size, and includes CAPITAL LETTERS, SMALL CAPITALS, lower-case (small letters), figures, joined letters (fi, ff, fl, etc.), and other signs such as &, £, etc. Type is made in standard sizes from 4 points to 72 points in body. Common sizes (Fig. 30) are 6, 8, 10, 11, 12, 14, 18, 24, 30, 36, 42, 48, and 72-point. This type that you are reading is 11-point with one point space between the lines.

Every type is cast in a mould (which shapes its body and width according to the letter it carries) and from a *matrix* (which decides the letter or character of the face). Matrices are made by stamping a steel *punch* into brass or copper. Punches are cut in soft steel which is afterwards hardened.

The typefounder (who supplies *type*) needs only one matrix for each letter (which can be engraved direct in a machine, to be described

ABCDEFGHIJKLMNOPQRSTUVWXYZÆŒ&

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ABCDEFGHIJKLMNOPQRSTUVWXYZÆŒ

£1234567890

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ABCDEFGHIJKLMNOPQRSTUVWXYZÆŒ&

abcdefghijklmnopqrstuvwxyzæœfiffflffiffl

FIG. 29.
Fount of type used in this book: 11 point Imprint.

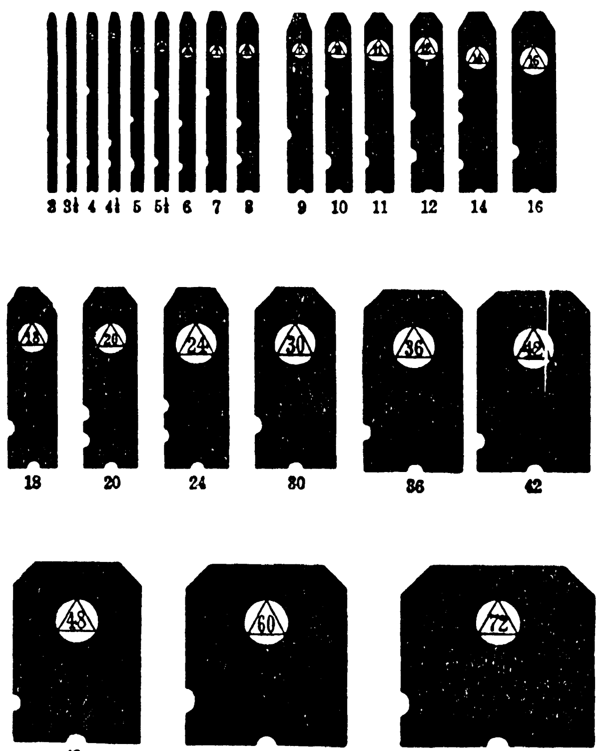


FIG. 30.
The exact sizes of type bodies.

later, similar to the punch-cutting machine) and he can cast as many types from it as are needed for his customers. The type-composing machine manufacturer supplies *matrices* to printers using the machines. These matrices are stamped by means of punches which are apt to break. He must therefore have at his disposal a model for re-cutting punches. This is supplied by a *pattern* which is made from a *drawing*.

Before describing the method of cutting punches and stamping matrices for composing machines, the early printer's method of making type may be mentioned.

All early punches were cut by hand (Fig. 31) with gravers and files, which was the only method used from the time of Gutenberg until the middle of the last century. Rudolf Koch cut many punches by hand and his son Paul is one of the few hand punch-cutters working to-day. Punch blanks are made of cast steel and softened by annealing. By means of gauges, lines are drawn on the face as a guide to the position of the character. The counter (or interior area) is struck in by means of a counter-punch. A counter-punch is an engraved punch of the counter (or interior shape) of a letter. Some counter-punches serve for several letters; some punches need no counter-punch; some need two. The punch is then finished by filing away unwanted parts of the face so that the letter stands out in relief. During this filing the letter is constantly examined under a magnifying glass and proofs are taken by blackening the face with lamp-black, breathing on a piece of soft paper and pressing the punch on to it. The first punches of a fount are called standards (H, O, M, P, h, o, m, p) and the others are based on them; all are made uniform in line, serif, and stroke. The work is slow and exacting. Arthur Nicholls (1637) says, 'The cutter and founder of Letters is 3 quarter of a yeares time cuttinge the Punches and Matrices belonginge to the castinge of one sorte of letters.' Fig. 32 shows the gauges, measuring tools, magnifying glass, file, and burin used in punch-cutting by hand. The vice is used for positioning and striking the counter-punch; on the right of it is shown the counter-punch, the punch after being struck with the counter-punch, and the finished punch.

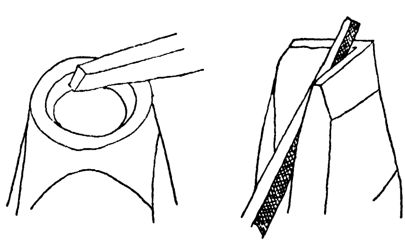


FIG. 31.
Cutting a punch by hand.

'A matrice,' (or 'strike'), says

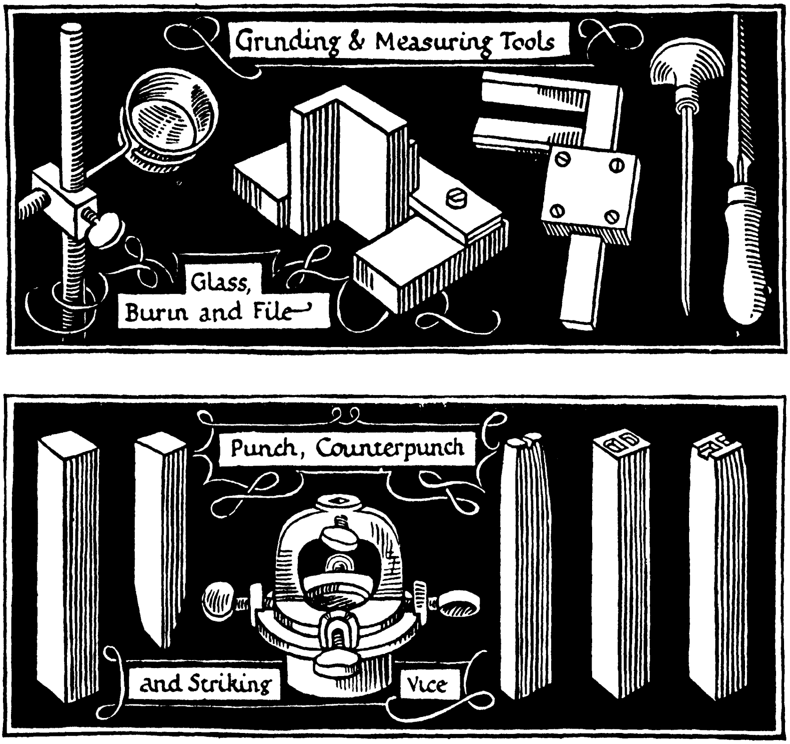


FIG. 32.
The tools used in punch-cutting by hand. Drawn by the late Rudolf Koch, who was one of the few remaining hand-punch cutters.

Moxon (1683), 'is a piece of brass or copper of about an inch and a half long, and of thickness in proportion to the size of the letter it is to contain.' The punch (Fig. 33) is struck into this and then 'justified,' i.e. filed and shaped to fit the mould. A matrix well struck is half-justified and striking needed a steady and practised hand. The punch was later struck by means of a similar apparatus to the vice shown in Fig. 32 in which a screw pressed the punch gradually into the copper, a vernier scale showing the depth of the 'strike.'

In foundries to-day matrices are engraved direct pantographically from a pattern or made by electrotyping.

The depression punched into a matrix blank forms the head of a type and needs some casting apparatus to form the shank or body of the type. Type (as distinct from slugs) is cast in a mould, the side of which can be opened or closed to the required width of the

type to be cast. All letters of one fount are cast on the same body; molten metal is poured in at one end and flows into the matrix which closes the other end. The mould forms the body up to the shoulder and the matrix forms the head which carries the face. The correct positioning of the matrix is important as it decides not only the up-and-down position (which must be uniform in all types so that the letters align when printed in lines), but also the allowance of space on each side of the types so that the space between the letters of a word will appear equal; the letters must not touch each other, nor be unduly separated. Several trial castings, which are compared with the other letters previously cast, are therefore necessary to determine this. After casting, the tang or jet is broken off, the type is rubbed gently on all four sides to remove burrs, the base is grooved with a planing tool to form the feet. Fig. 33 shows a punch, a matrix, and a type before it is 'finished.'

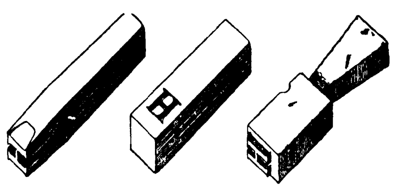


FIG. 33.
Punch, matrix, and cast type. The superfluous metal at the base of the type (the tang or jet) is broken off and a groove, made with a planing tool, forms the feet.

The manufacture of matrices for composing machine (Plate III) starts with a drawing, which is made from either an original sketch by a designer, an existing type, or a print from a type. The original is projected in a lantern on to paper in a dark room and a tracing made. The tracing (which follows all the imperfections of the original, such as the splurge of the ink in a print or wear on a type) is used to make a working drawing in which the imperfections are remedied, and curves, serifs, and other parts are rationalized. The drawing, about 10 ins. square, contains all subsequent working dimensions, measured to ·0001 in.

This drawing is used to make a pattern, which is a copper-faced plate about 3 ins. square and ¼ in. thick, and has a character raised about $\frac{1}{16}$ in. on its face. The Linotype pattern consists of two plates soldered together; the pattern is then cut pantographically through the top plate. The two plates are riveted together on the parts forming the character, and when the solder is melted and the superfluous metal removed, the raised letter is left standing out. The Monotype pattern is made as follows: a piece of glass is coated with wax; a needle, cutting as deep as the wax, actuated pantographically, is guided by a follower which follows the lines of the drawing and cuts the letter shape; the wax core is then removed. In cutting this wax the

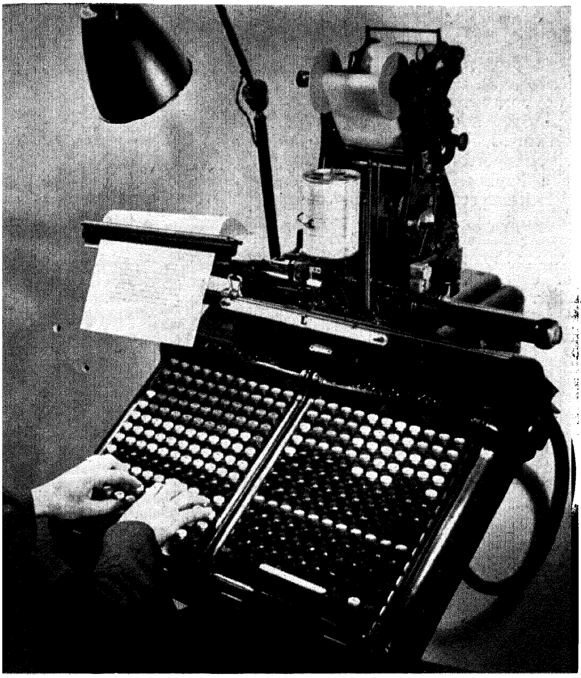
follower uses the same french curves and straight edges as were originally used for making the drawing. After sensitizing, the glass plate and wax are placed in an electrolytic bath and a thin sheet of copper is deposited on the face of the wax. This shell of copper is then backed with type metal.

The pattern now goes to the punch-cutting machine,* which is a vertical pantograph with a pendulum-like arm pivoted above the table where the pattern is mounted. In the centre of the crossbar at the top is a vertical shaft ending at its lower end in a ball-joint which is contained in a vertical carrier. An adjustment allows variation in the ratio between the ball-joint and the pivot of the pendulum so that different sizes may be cut from the same pattern. The punch is mounted in a sliding carrier in inverted position. Below it is a crossbar containing a spindle running at high speed. This spindle contains a four-sided pyramidal cutter of hard steel. The lower end of the pendulum follows the outline of the pattern while the other end is operating the sliding carrier containing the punch. The cutting tool (in the crossbar) which is controlled independently, cuts into the soft steel punch and makes a reduced replica of the pattern. The follower has a series of formers (metal discs) of different sizes. The larger ones are used first, and the edges of the pattern-letter are gradually approached by using smaller formers. The cutting process consists of several circuits around the pattern, resulting in decreasing depths of cuts on the punch; the final cut removes only ·0004 in. The punch is then hardened in a furnace, justified, ground, and trimmed to fit the matrix-stamping machine.

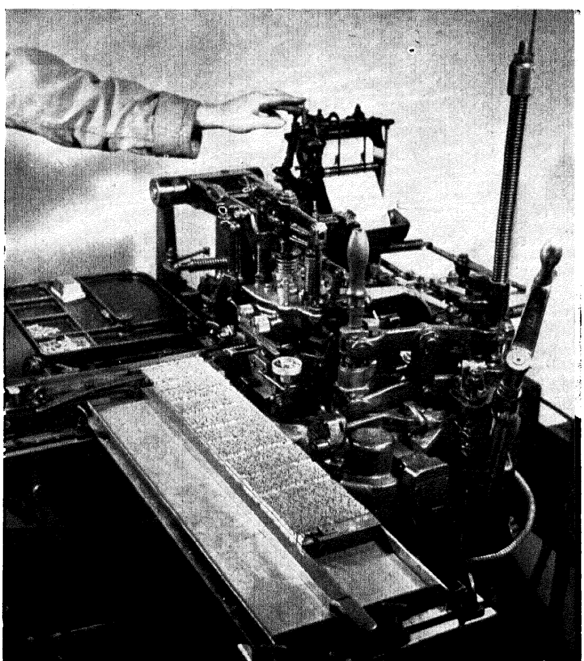
The form of matrices used with type-composing machines varies considerably from those used by the typefounder. The Linotype and Intertype matrix (Plate V) has to be made so that a number may be assembled and presented to a mould for casting a complete line; it has to be provided with parts that enable it to be transported around the machine. Linotype matrix blanks are sawn from a roughly shaped bar or stamped out from strip brass of various thicknesses, a little thicker than the finished matrix is to be. The blanks are then trimmed and shaved, grooved, and shaped to stock sizes. The reference number of the fount and the character are stamped (on the opposite side to the face) and then filled with black pigment, so that the operator when setting type can read the assembled

* The pantographic punch-cutting machine was invented by Linn Boyd Benton in 1885, and punch-cutting machines to-day are versions or modifications of his invention.

Monotype Keyboard



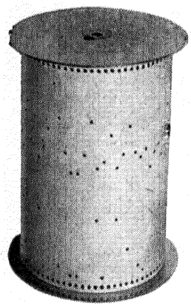
Each tap of a key perforates the paper ribbon and—



when this ribbon is taken to the casting machine it causes types to be cast and set in evenly spaced lines at high speed.

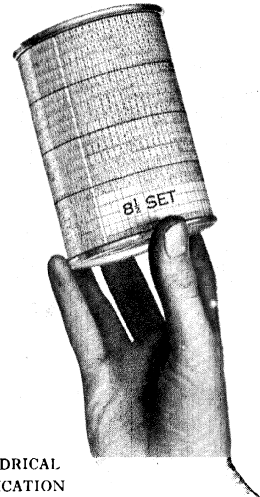
Monotype Caster

PLATE VIII

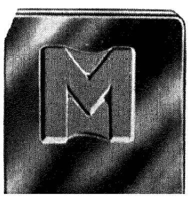


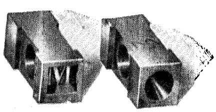
PAPER RIBBON

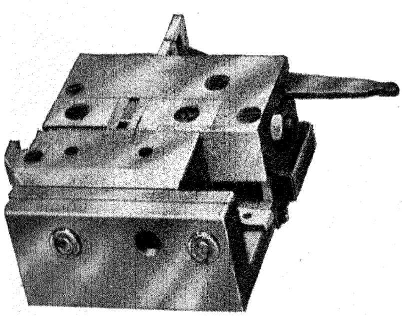
The composing and casting of type on a Monotype machine is controlled by a ribbon (*left*) which is perforated by an operator at a keyboard (Plate VII). A cylindrical scale (*right*) indicates to him at the end of each line the keys which are to be depressed to actuate the automatic justification (or even spacing of each line) when the ribbon is placed on the casting machine.



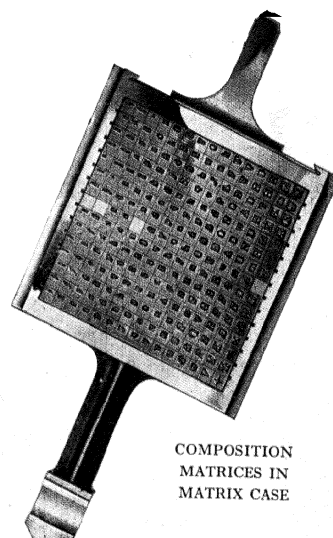
CYLINDRICAL JUSTIFICATION SCALE







COMPOSITION MOULD



COMPOSITION MATRICES IN MATRIX CASE

The matrices on Monotype machines are of two kinds: composition matrices (up to 14 point) are held in a matrix-case which contains 225 or more; display matrices are used for casting larger types. The mould in which the types are cast consists of three steel blocks with a sliding mould blade which is opened to the width of each type and space as it is cast.

line. Fount slots are then cut in the lower edge, which prevent matrices of the wrong fount from entering the magazine of the machine, so serving the same purpose as nicks on type. A groove is then made to take the letters to be punched. A Linotype matrix normally has two letters on it—one roman and the other italic or a bold face. This punching is carefully controlled as it determines the height of the type. Other processes include the milling of the rough form of the teeth, cutting a full set of teeth, and 'combinating' or arranging the teeth so that the matrices will fall into their correct slots in the magazine as they pass along the distributor bar.

A Monotype matrix is a prism of bronze, containing in its lower end the die or intaglio impression of a character, and at the upper a conical hole by means of which the matrix is correctly positioned over the mould at the time of casting (Fig. 34). The matrices are held in a matrix-case (Plate VIII) by means of a rod running through their bulk. Larger matrices for casting large types (18 point and over) are rectangular and are chromium-faced.

The smaller matrices are cut from a bar of phosphor bronze. These blanks are stamped with a reference number and sized. They are then fed by means of a holder into a stamping power press, which punches the blank with the character engraved on the punch, the depth being exactly determined and electrically controlled. They are then trimmed to correct depth, holed, and coned. All matrices undergo the most exact inspection; a fifty-times enlarged image of a matrix is reflected on a squared background, the squares representing one-ten-thousandth of an inch.

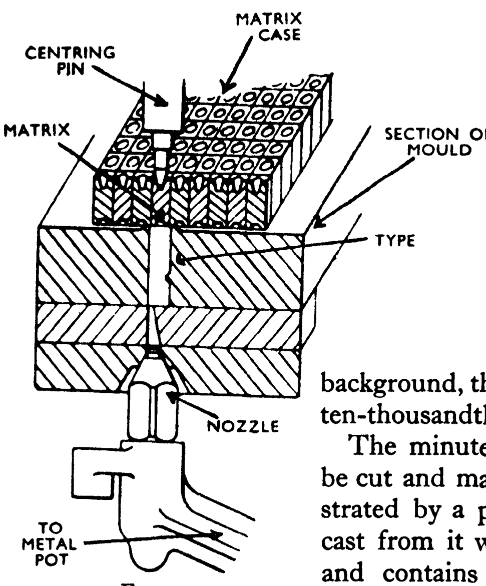


FIG. 34.
Showing how single types are cast on a Monotype Caster.

The minuteness to which punches can be cut and matrices stamped was demonstrated by a punch, a matrix and a type cast from it which measures $\frac{1}{8}$ in.$\times\frac{1}{8}$ in. and contains the whole of the Lord's Prayer and the name and address of The Monotype Corporation Limited.

Linotype matrices are contained in channels of an inclined magazine. When a key is depressed (Plate VI) on the keyboard, a matrix is released and falls through guides on to an inclined travelling belt and is carried to an *assembler box*. After each word a *spaceband* is released from a box above. A spaceband consists of two opposing wedges sliding upon each other. When the assembler box contains sufficient for a line, the line is taken to the casting position, the wedges are forced upwards and so increase the spacing to the required amount. Molten metal is then pumped into the mould (which is a slot in the mould wheel) and into the dies of the matrices. The mould consists of two steel blocks screwed together and separated by two steel pieces called *liners*. Both liners are of the same thickness as the body of the type being cast; the *measure liner* determines the length of line (the shorter the liner the longer the measure). Body size is changed by changing the liners. The raised ribs on the slug are formed by grooves in the mould; these grooves and the foot of the slug are trimmed and give the slug its correct body and height. The matrices are then transferred by an arm elevator to the top of the magazine where they travel along a *distributor bar*, the ribs of which vary in number and length to correspond with the varying teeth of the different matrices. Each matrix is engaged by its teeth on the bar until it arrives over its appropriate channel, where the combination of teeth allows the matrix to disengage and fall into its own channel. The matrices are carried along the bar by longitudinal screws which engage their projecting ears and feet.

A Monotype machine consists of two parts, a keyboard and a caster. The keyboard (Plate VII) prepares a perforated ribbon which controls the caster. The operator at the keyboard depresses the keys which perforate the ribbon (usually with two perforations). As each key is depressed its value in units is registered. This is repeated until the line is set. The line is 'justified' (i.e. spaced out to correct width) by the depression of two figure keys which are automatically indicated to the operator by a pointer on a cylindrical scale. When the operator has made this record it is taken to the caster. The ribbon may contain 40,000 characters; it is $4\frac{3}{8}$ in. wide.

On the caster is a tower (on which the paper ribbon is placed) with a bar containing a row of 31 holes, which are connected by pipes to two blocks at right angles to the mould. Each block contains 15 stop pins. The paper ribbon is automatically advanced over the holes, and the perforations cause, by compressed air, one stop pin in each bar to rise and so stop a feeler moving in their paths. These

pins determine the various positions to which the matrix case is brought over the mould, which may be any of 225. These stops also operate two wedges that control the mould blade opening; one determines the width of type and the other the width of spaces. The matrix-case contains the matrices (·2 in. × ·2 in.), which are arranged in 15 rows with 15 (or 17) in each row. The characters in each row are of equal unit value, and there are about 12 different thicknesses of characters. Each row has a definite unit value, the thinnest being 5 and the thickest 18 units. When the required matrix is brought to position (Fig. 34), it is clamped to the mould; an accurately adjusted coned pin enters the coned hole in the matrix and brings the matrix to the correct position upon the four sides of the casting cavity of the mould and makes a metal-tight joint. The mould consists mainly of two steel blocks fixed at a distance equal to the body of the type being cast. At the end of the parallel groove formed by these blocks is another block, and sliding in the groove is the mould blade, which is automatically adjusted to the width of each type and space just before it is cast. The body of the type is determined by the thickness of the mould blade, and its width by the automatic adjustment of the blade, narrow for 'i', wider for 'W'. When each type is cast it is ejected from the mould and carried to a tray called a galley. Types can be cast at a rate of 140 to 160 a minute and are cooled by water. Casters can also be adapted to cast type for cases in any size up to 72 point, as well as leads, spacing material, metal for mounting stereotypes and other plates, and decorative borders in units or strips; and other mechanisms are available for automatic leading lines as they are cast, very close spacing, and automatic centring of lines.

Single types and spaces in composing rooms are kept in cases (divided into boxes) which are mounted on frames. Cases are of various kinds according to the amount and sizes kept in them. Before composing machines were invented, all typesetting was done by hand. Body types (types of 14 point and smaller for straightforward reading matter) are carried in pairs of cases, an upper case and a lower case. The lower case rests on the lower part of the frame and the upper case rests above it. Spare cases are kept in racks underneath the frame. The lower case contains, mainly, the small letters (a, b, c, d, etc.) and the upper case capitals (A, B, C, etc.), small capitals (A, B, C, etc.), and signs. The size of the boxes varies in the lower case according to the frequency with which the letters are used, the largest box containing e. The upper case has 98 boxes

of equal size. Special cases are used to contain large wooden letters for posters, borders, brass rules, and other printing units.

In addition to printing units, the printer stocks various kinds of spacing material: *leads* are thin strips of lead alloy of various thicknesses from 1-point to 3-point; *reglets* are thin strips of wood of 6 and 12-point in thickness; wood *furniture* is 24, 36, 48, 72 and 96 points in thickness (usually referred to as 2-em, 3-em, 4-em, 6-em, and 8-em, the em signifying 12 points). Other furniture is made of lead alloy of various multiples of the 12-point em in dimension. Furniture is used for spacing or blanking out areas where no type is to print and also for filling out the *chase* (an iron frame in which the assembled pages are locked for transport to and from the printing machine). In bookwork the margins are decided by the disposition of such furniture in the forme.

Spaces and quadrats ('quads') are used to space words and lines, and are always related to the body of the types with which they are used. Thus an em-quad is the square of the body of any size of type. A 10-point em is 10 points wide and 10 points deep. Quads are also available in 2, 3, and 4-ems width. Spaces are available in several widths: a *thick* space is a third of the em; a *middle* space is a quarter, a *thin* is a fifth, and a *hair* space is an eighth; thinner copper spaces are also used. By varying the combination of these spaces, the compositor spaces each line in a little hand tray called a composing stick.

On composing machines even spacing between words is effected automatically. On Monotype machines the 'em' is related to the width-standard of the type design. A design which is of narrow proportion (narrow 'set') has an 'em' which is not identical to its body. A 10-point type may be 8½-set; the 'em' will therefore be 10 points in body and 8½ points wide. In this way the spacing is related strictly to the design, and is in general narrower than with a fount of wider set, such as a 10-point 10-set design.

Metal types are, as we have seen, cast from various kinds of moulds. The metal used is an alloy of lead, antimony, tin, and sometimes copper. This alloy fulfils the requirements of density, ductility, and fusibility at low temperature. Lead forms the basis of the alloy; it is soft and contracts on cooling. Antimony is brittle and expands on cooling, thus counteracting the contraction of the lead; it gives sharpness to the face of the type. Tin is hard and tough and amalgamates well with both lead and antimony; it also serves as a solder, oxidizes slowly, and prevents oxidation in its alloys. Copper gives

durability and additional hardness, but requires a high melting temperature and does not mix well. The combination of the properties of these constituents of type metal results in an alloy that solidly fills the mould and shrinks little after casting. This alloy will not rust or corrode, and is little affected by the action of water, air, heat, lye, oil, and other solutions with which it is likely to come into contact during the printing process. Type metal is soft in comparison with some other alloys, wears out in continued use and is easily damaged.

Recently there have been attempts to mould types from plastics. Machines for producing the cast units have a melting chamber in which the resin is made plastic and exuded through a nozzle. The development will undoubtedly lead to the construction of high-speed presses of reduced weight, as the plastic is only about a tenth of the specific gravity of metal, wears better than metal for continuous printing, is unaffected by the normal solvents, lye, or humidity, and can be remelted without deterioration. Its application to type-composing machines provides a problem for further research and experiment.

CHAPTER VII

CONTEMPORARY TYPE DESIGN AND TYPOGRAPHY

CONTEMPORARY type design in this country since the last war has been largely concerned with revivals of type faces of the past and their intelligent recutting for modern uses. This revival may be said to have begun with the type designed for *The Imprint* magazine in 1911, and the Imprint type (Fig. 36) was the first of a long series of revivals or re-interpretations of type designs of the past. The composing-machine manufacturers were at first content to supply matrices made from designs of existing types, but later began to originate their own. This work was notably furthered by the appointment as typographical adviser to the Monotype Corporation of Mr. Stanley Morison, who was quick to appreciate that public taste had first to be won for good design in type before any venture could be made into the field of original contemporary design.

Interest in type design, which had originally been quickened by the Kelmscott and Doves Press re-cuttings of Jenson's letter of 1470, was further encouraged by the calligraphic teaching of Edward Johnston, whose work inspired original design in type by Weiss, Koch, Behrens, Renner, and others in Germany. The able editorship of Oliver Simon and Stanley Morison of *The Fleuron* (1923–1930) and Mr. Morison's other valuable writings on the history of letter form, typography, and printing technique, his scholarly but practical supervision of the revivals of classic type designs, are not only an important contribution to the present-day renaissance in the printed book but have provided a critical apparatus for the appreciation of original design in type.

Frederic W. Goudy, the American, is the most prolific of our contemporary designers, and he has been responsible for a hundred and twenty designs. Distinguished work has also been done by Bruce Rogers, William Addison Dwiggins (for the Linotype), and Hunter Middleton (for the Ludlow machine).

The following survey of contemporary type design will be better understood by the reader if some rough classification is given. It should be observed that there are a great number of type designs, that many are almost identical, and that the names given to types are rarely descriptive but usually relate to their origin.

Before the nineteenth century, jobbing types as we know them to-day did not exist, although decorated types had been used, notably in the eighteenth century by typefounders who imitated the work of the French copper engravers. Printing before the nineteenth century was almost entirely book-printing and it will be convenient therefore to review first of all types used for books.

We noticed in Chapter III that the first perfected roman was that of Nicolas Jenson. Morris's revival of this letter led the type-founders to follow, and of this form of letter there are Jenson (Lud),* Centaur (a highly individualistic interpretation by Mr. Bruce Rogers) (M); Venezia (L), and Cloister (ATF). These types, in general, may be identified by the tilted eye-stroke to the e, the curved tail to R, and the upper serifs of M which continue across both sides of the mainstrokes.

The type used by Aldus in 1495 was the first *old face* and the style was continued for several centuries. The design is more refined than the types of the Venetian group and there is generally more contrast between thick and thin strokes. Those in current use include Bembo (M) and Poliphilus (M) which are revivals of the Aldine letters, Granjon (L), Estienne (L), Plantin 110 (M), Van Dijck (M), Ehrhardt (M), and Caslon's well-known letter.

Types which are transitional between the *old face* and the *modern* are Baskerville (M), Fournier (M), and Georgian (L).

The *modern* design is represented by Bell (M), Bodoni, Scotch, Walbaum (M), Century, and many others. In these types the serifs are usually horizontal, the stress is vertical (as distinct from biased as in *old face* and *old style*), and there is a sharp contrast between thick and thin strokes.

The *old style* (which is a regularized or modernized *old face*) exists in many versions, notably Imprint (M), Bookprint (L), and Ronaldson.

Original book types designed by contemporary artists are Perpetua (M) by Mr. Eric Gill, Romulus (M) by Mr. J. van Krimpen, Electra (L) and Caledonia (L) by Mr. W. A. Dwiggins, Goudy Modern and Goudy Old Style by Mr. F. W. Goudy, Times (M and L), Fairfield (L) by Rudolph Ruzicka, Weiss by E. R. Weiss, An interesting feature of the Electra, Perpetua, and Romulus types is the sloped roman (as distinct from the customary italic) which is used with them.

* The abbreviations following the names of type faces represent American Type-founders Company (ATF), Linotype (L), Ludlow (Lud), Monotype (M), and Stephenson, Blake & Co. Ltd. (SB). Where no indication is given the design is marketed by several firms.

SPECIMENS OF CURRENT BOOK FACES

Although related to the traditional shapes inherited from Aldus, through Garamond, Plantin, Van Dijck, and Caslon, the Baskerville letter ranks as the first definitely English design. *The italic is even more novel when compared with any previously cut.*

John Baskerville of Birmingham, who designed this letter, was born in 1706. He became a writing-master, and it was not until 1750 that his interest turned towards printing. He designed his type in accordance with the formal lettering evolved by the early eighteenth-century writing masters, and during the next twenty-five years printed and published a large number of editions of English, Latin, and Greek classics in octavo and quarto. Apart from the novel cut of his letter, Baskerville exerted a tremendous

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The advent of the Bembo type face, cut in 1929 by the Monotype Corporation, restored to the printer's typographic repertory *the earliest old face design in the history of printing*. This famous prototype was originally used for a short Latin tract by Pietro Bembo (later Cardinal) which was published in 1495 and printed by that most famous of all early Venetian printers, Aldus Manutius. The punches were cut by Francesco Griffo da Bologna, the designer of the first italic letter used in printing. The importance of this historic letter was overlooked in the revival of printing fostered by William Morris and other private presses by their pre-occupation with the types of an earlier master, Nicolas Jenson. Jenson's types, famous as they were in the late fifteenth century, did not have a long life; no

---

A fresh direction was given to the development of the Modern face by Alexander Wilson in 1833. Wilson's letter is sharper in cut than its predecessors, *but not strikingly original in design*. The Scotch face was based directly or indirectly upon one of the founts shown in Firmin Didot's specimen of 1819, which in turn owed much to the designs of Giambattista Bodoni of Parma. These types had considerable vogue on the Continent but were slow in coming into use in England. The t is a characteristic letter. At first issued, the Scotch type (as it came to be called) was a neat and open letter, its ascending letters were well proportioned and the face avoided all excesses, so that it quickly achieved a high place in the esteem of printers. More condensed forms were later cut for newspaper work.

FIG. 35.
Baskerville, Bembo, and Scotch.

GARAMOND: Between 1531 and 1536 the Paris type founders gradually *copied the Aldine model of the roman letter* and slowly the design cut by Claude Garamond became the standard type over all Europe. The sale of Garamond's effects at his death further dispersed his

FOURNIER: Pierre Simon Fournier cut types after the *romain du roi* model but slightly narrowed it, modified the serifs, and avoided fancy letters. He cut many variations. These different nuances of the face were made as much in the interests of beauty as of use. The *petit œil* leaves more space between

CASLON OLD FACE: The credit of the Caslon revival must be shared by both Pickering and Whittingham. Small amounts of Caslon's type had been used in titles and preliminaries since 1840 and Pickering used the great primer size in his *Common Prayer* (1844) before it was used in 1845

John Bell was a bookseller at 24 years of age, a newspaper owner at 27, and in 1772 he published *The Universal Catalogue*. He owned *The Morning Post* for 15 years. In 1787 he used his own type for *The World* and the first specimen of it was issued in 1788. It was the first English

OLD STYLE NO. 2: In 1852 Miller & Richard of Edinburgh issued a modernized old style, cut by A. C. Phemister. Old style types have a greater x-height than the old face of Caslon, the serifs are short, stubby, angular, oblique, and bracketed; *the italic shows a*

BODONI: The chief note of the modern face is the strong contrast between thick and thin strokes which are disposed vertically in rounded letters, the length and fineness of the serifs and the precision in cut. *The italic is graceful and easy to read.* Bodoni (born

IMPRINT: The cutting of this type showed that type could be well set by machine. Imprint, with its *fully kerned* letters and careful cutting, proved that, at last, machine setting could compete with the best hand-set type. *The Nonesuch Press* drove the lesson home by using, almost

MR. F. W. Goudy (*pronounced Gowdy*) is one of the few who have designed type faces of wide popular appeal which were not taken directly from the early models. Since 1926 Mr. Goudy has been the art director of the Lanston Monotype Machine Co. of America. Thus several of the fine types designed by him have also

TIMES: This face is modern in cut (the serifs are very sharp-pointed) and its thick and thin strokes are sharply contrasted. It is modern in its proportions for it has a greater x-height than any other face in the Aldine group. *The italic has many true serifs and is also sharp in cut.*

PERPETUA: Designed by Eric Gill, the hand of the stone-cutter can be clearly seen in this design, especially in the small letters whose clear-cut rigidity is reminiscent of the sculptor's tool rather than of the calligrapher's pen. *The italic is really a sloped roman* and therefore in greater harmony with the roman than is

FIG. 36.

Book faces of to-day: Garamond, Caslon Old Face, Old Style 2, Imprint, Times, Fournier, Bell, Bodoni, Goudy Modern, and Perpetua.

The foregoing includes only the more notable book types used to-day, and those that are representative of the group to which they belong.

The printing industry to-day consists of three main groups: book, newspaper and periodical, and jobbing or general printing.

The first weekly periodical, the Augsburg *Aviso*, appeared in 1609, and the *corantos*, *relations*, and *diurnals* which followed were the precursors of our modern daily newsheets. These early newspapers used *old style* types of their period, but in 1799 *The Times* adopted the *modern* face, and others followed.

Until 1930, when the *Daily Herald* began to use the Ionic type (Fig. 37), a face that had been used in such leading American newspapers as the *N.Y. Times*, and the *N.Y. Herald Tribune*, there had been no change in the type used by newspapers.

The vogue of Ionic spread to the *Daily Express*, *Daily Mail*, and *News Chronicle* in 1933. The Ionic letter was considered a vast improvement over the weedy-looking *moderns*, and the heaviness of its design was also considered to stereotype better and give better results under newspaper printing conditions of thin inks, rubber rollers, and fast-running presses.

It was not until *The Times* began to concern itself about the matter that the advantages of Ionic were challenged. After some experiment *The Times* decided to retain the proportions of the *modern*, to increase the weight of the design, but to dilute the heaviness of Ionic by reducing the weight of substrokes where they join the mainstrokes. This variation in thick and thin stroke avoided the flat monotony of Ionic. Thus the new letter used by *The Times* achieved a face as strong in colour as Ionic, at least as legible, which did not need leading or interlinear space, and which occupied much less space (Fig. 37). *The Times* then took the next logical step and commissioned a series of types for headings which were related in design to the text type.

It has been mentioned that the first jobbing types were egyptians and sanserifs. The egyptian letter has inspired several contemporary designs: Beton, Cairo, Girder, Luxor, Memphis, Rockwell and Stymie. The sanserif letter owes it revival in this country to the letter designed for the London Underground by Edward Johnston, where the forms of the letters were made to the proportions of the pure roman epigraphic capitals of the first and second centuries. Under the influence of the modernistic typographical movement on the Continent some of the German typefoundries began to experi-

ment with sanserif designs based on geometric principles; such are the Erbar, Futura (which its designer claimed to be 'a type without a prototype'), and Kabel (or Cable) types. Eric Gill, a pupil of Edward Johnston, was responsible for the now almost (in this country) ubiquitous Gill Sans of The Monotype Corporation, also made by Stephenson, Blake & Co. Ltd. in large sizes of wood letter for posters. Other versions of contemporary sanserif designs are Metro (L), Granby (SB), and Tempo (Lud).

The principle of fattening a design (used in the earliest display types) has been widely applied to text types and many have emboldened versions: Garamond, Plantin, Caslon, Bodoni, Perpetua, Times, Goudy, and so on. This principle of variation in the basic design of a letter was first used by the originators of the Cheltenham type (Fig. 23), where as many as seventeen varieties occur in this type family. Other jobbing types, such as Gill Sans (Fig. 39), the

The invention of Printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters

The invention of Printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest

FIG. 37.

Comparison of two type designs of the same body size: Ionic and Times Roman. In the first example there are 55 words; in the second there are 72 words. The area is about 3½ square inches.

Plantin Bold	Perpetua Bold
Bodoni Bold	Times Bold
Goudy Bold	Studio
Albertus	Temple Script
Condensa	Gillies Gothic
PLAYBILL	Matura
Allegro	Signal
Ariston	Amanda
Legend	Locarno
Trafton Script	Coronet
Eden	Stellar
Chisel	Holla
LYDIAN	PRISMA
DELPHIAN	ROCKWELL

FIG. 38.
Contemporary Display Faces.

GILL SANS

AND ITS RELATED DESIGNS

Extra Light & *Italic*

Medium & *Italic* **Bold & *Italic***

Extra Heavy Ultra Bold

Medium Condensed **Bold Condensed**

Extra Condensed

EXTRA BOLD TITLING

Gill Sans Shadow Line

SHADOW

SHADOW

CAMEO

CAMEO RULED

FIG. 39.
Gill Sans and some of its related designs

Here are two type faces of the same body size, which are set to the same length. One uses up lateral space, the other saves it. There can be a difference of more than 50 pages in book which has 60 thousand words.

Here are two type faces of the same body size, which are set to the same length. One uses up lateral space, the other saves it. There can be a difference of more than 50 pages in a book which has 60 thousand words.

FIG. 40.
A comparison of a wide and a narrow type design of the same body size (Fournier and Baskerville).

Hop **Hop**

FIG. 41.
Both these types (Centaur and Plantin) are of the same body size (60 point). Note the difference between the area occupied by non-ascending and non-descending lower-case letters. This area is known as the x-height.

egyptians, and so on, have also light, medium, bold, bold condensed, and other versions of the original basic design.

Another popular kind of jobbing type is script, which imitates the informality and cursiveness of handwriting, such as Gillies, Grayda, Holla, Mandate, Quick, Temple, Signal, etc. These types were largely introduced by the typefoundries of Germany, inspired perhaps by the exploitation of the freer or more cursive styles of gothic types by such designers as Professor O. W. Hadank and the teaching of the Johnston-Simons school of calligraphy.

In this connection it must be admitted that, in the field of jobbing or display type design, the typefounders of this country have tended to follow laggardly in the footsteps of the German and American foundries. English typefounders seem to be convinced that there is little native talent in their own country for type designing. Even in the U.S.A. the leading type designer, Mr. F. W. Goudy, deplores that 'it is a lamentable fact that for the past ten years foreign importations have almost driven our own productions into the limbo of the forgotten,' and that 'it has been largely our German contemporaries who have produced the bulk of original type.'

Ornamental types are of many kinds; there are outline designs, reversed letters, shaded letters, and other forms of decorated types. They are so numerous and varied that no detailed account can be given here.

The reader may be tempted to enquire why the printer does not

7 point Ionic 451 (SOLID).

I need not remind the House that we are come to a new era in the history of nations: that we are called upon to struggle for the destiny, not of this country alone, but of the civilized world. We are in the first place to provide for our own security against an enemy whose malignity to

8 point Times 327 (SOLID).

I need not remind the House that we are come to a new era in the history of nations: that we are called upon to struggle for the destiny, not of this country alone, but of the civilized world. We are in the first place to provide for our own security against an enemy whose malignity to this country knows no bounds:

10 point Fournier 185 (SOLID).

I need not remind the House that we are come to a new era in the history of nations: that we are called upon to struggle for the destiny, not of this country alone, but of the civilized world. We are in the first place to provide for our own security against an enemy whose malignity to this country

7 point Ionic (LEADED 3 POINTS).

I need not remind the House that we are come to a new era in the history of nations: that we are called upon to struggle for the destiny, not of this country alone, but of the civilized world. We are in the first place to provide for

8 point Times 327 (LEADED 2 points).

I need not remind the House that we are come to a new era in the history of nations: that we are called upon to struggle for the destiny, not of this country alone, but of the civilized world. We are in the first place to provide for our own security against

10 point Fournier 185 (SOLID).

I need not remind the House that we are come to a new era in the history of nations: that we are called upon to struggle for the destiny, not of this country alone, but of the civilized world. We are in the first place to provide for our own

FIG. 42.

A comparison of Type Faces of the same x-height but of different set and body size. 7 point Ionic, a wide face, saves interlinear space but uses lateral space. 8 point Times saves both interlinear space and lateral space, and loses little in roundness of form. 10 point Fournier uses interlinear space but conserves lateral space. Ionic needs at least one point leading to overcome its oppressiveness; Times allows sufficient relief and conserves two points of interlinear space over Fournier. The lower three examples show the effect of these types when occupying the same body depth.

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FIG. 43.

Examples of Modern Jobbing Work.

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Grounds of 30 Acres with lovely View of the South Downs.
Golf, Croquet, Tennis and Bowls.
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Apply Manageress.

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M M announcing

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MADAME MADELEINE PARIS·MIAMI

FIG. 44.
Display work set in Legende, Futura, and Corvinus.

determine for himself the qualities that make for legible and serviceable type design and thereafter restrict himself to the use of a single design. It is obvious that, in order to give prominence and interest to various kinds of public announcements, sales literature, newspaper and periodical advertisements, and other ephemeral and heterogeneous printing, there must be variety. This is due to the need for freshness and originality in presentation. The need for

different kinds of book types is perhaps less apparent, but monotony must be avoided, paper surfaces require different kinds of design, the spirit or period of the subject matter often needs to be reflected in a type face, and variety is desirable in page texture to harmonize with varying kinds of illustration and illustration processes. The type design may be chosen to conserve or to use space. Novels, for instance, sold at the same price (however different the number of words they contain) must appear to be of the same bulk. The use of a wide open type, generously line-spaced or leaded and printed on a thick paper, can make a book look as good money's worth on the stall or in the shop window as a longer one printed on thin paper in a narrow type which is not leaded (Fig. 40).

Types, therefore, differ widely in design: some are large for the body size (Figs. 41 and 42), some are heavy in weight, some are perhaps too individual. A good book type is one that does not obtrude itself and that has no characteristics that disturb the smooth onward flow of the reading. In printing other than for books, more variety in design is desirable. The book is sold as a unit for its subject matter, and an interest in its contents does not have to be stimulated by typographic display. An advertisement, blotter, advertising folder, envelope stuffer, and so on, must express its message more forcefully and persuasively to turn the spectator into a reader and the reader into a buyer; in catalogues, time-tables, price-lists, there is a need to distinguish between parts of the text that differ, and as many as seven alphabets (roman capitals and lower-case, italic capitals and lower-case, small capitals, bold capitals and lower-case) may need to be employed.

With regard to revivals, the aim of the typefounder or composing-machine manufacturer is rather to translate designs of the past in terms of modern needs of printing technique and not to copy slavishly. Early methods of hand punch-cutting and typefounding could not ensure perfect coincidence of form throughout the different sizes of a type series. It is not therefore desirable to copy the idiosyncracies which are present in such a series of types. The wide range of paper surface and the different printing processes, again, enable the printer to-day to obtain variations in texture with the same type face, so that a type design is merely a potential that can be varied at will. Plantin's type of 1567, for example, was revived because it gave good colour on art paper and sturdiness in press advertising, not because it might stimulate antiquarian interest in a famous sixteenth-century printer.

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Harmony
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ROMARY

'TUNBRIDGE WELLS' BISCUITS

FIG. 45.
(*Above*) Business card in Bodoni Family.
(*Below*) Announcement in Walbaum.

FOR MAIN BOOKING OFFICES SEE BACK COVER 4 EVERY TELEPHONE A BOOKING OFFICE

THE VIKING ROYAL MAIL EXPRESS

(Connecting at Copenhagen with the service of A.B. Aerotransport to Stockholm)

EFFECTIVE FROM NOVEMBER 1 UNTIL FURTHER NOTICE

DAILY SUNDAYS EXCEPTED

The local time in Germany and Scandinavia is one hour in advance of Greenwich Mean Time (London).

SERVICE 329

LONDON—MALMÖ		Local Time
LONDON (Terminal House)	dep.	08.15
LONDON (Croydon Airport)	dep.	09.00
* HAMBURG (Fuhlsbüttel Airport)	arr.	13.00
* HAMBURG (Fuhlsbüttel Airport)	dep.	13.25
* COPENHAGEN (Kastrup Airport)	arr.	14.40
COPENHAGEN	dep.	14.50
STOCKHOLM	arr.	17.00
* COPENHAGEN (Kastrup Airport)	dep.	15.00
MALMÖ (Bulltofta Airport)	arr.	15.15
MALMÖ (Central Station)	arr.	15.45

SERVICE 329

MALMÖ—LONDON		Local Time
MALMÖ (Central Station)	dep.	12.10
MALMÖ (Bulltofta Airport)	dep.	12.40
* COPENHAGEN (Kastrup Airport)	arr.	12.55
STOCKHOLM	dep.	09.30
COPENHAGEN	arr.	11.40
* COPENHAGEN (Kastrup Airport)	dep.	13.20
* HAMBURG (Fuhlsbüttel Airport)	arr.	14.40
* HAMBURG (Fuhlsbüttel Airport)	dep.	15.00
LONDON (Croydon Airport)	arr.	17.15
LONDON (Terminal House)	arr.	18.00

RAIL CONNECTIONS FROM MALMÖ

		Local Time
MALMÖ	dep. 17.20	21.48
GOTHENBURG	arr. 22.12	02.24
OSLO	arr. —	09.00

NOTE.—Lockheed Electra airliners, with a cruising speed of 175 m.p.h. are operated on this service.

* See page 1 for ground transport services between City terminus and airport.

RAIL CONNECTIONS TO MALMÖ

		Local Time
OSLO	dep.	20.05
GOTHENBURG	dep.	02.49
MALMÖ	arr.	07.42

FIG. 46

Example of the use of several versions of Gill Sans (Light, Medium, and Bold).

BAXTED

Dormington Road

HEREFORD

★

OLD ENGLISH AND
FRENCH FURNITURE

★

TAPESTRIES AND TEXTILES

★

INTERIOR
DECORATION

★

The finest selection in this district
Established over fifty years

FIG. 47.
Announcement set in the Perpetua Series.

Some factors which affect the appearance of a type design are partially worn typefounder's type, new typefounder's type, machine-set type, rough or smooth paper surface, stereotyped type, printing process, viscidity or otherwise of ink, and so on, factors which are almost infinitely combinable.

In the past twenty years or so the growing interest in printed matter has led to the revision and re-designing ('re-styling' as it is called) of forms of printing that were still, in effect, as they were in the nineteenth century.

The L.N.E.R. has for all its printed matter (except, of course, books and booklets in continuous text) adopted one style of type design, the sanserif designed by Eric Gill, and within its convention the time-table has been re-styled in logical and readable form. Other transport concerns have followed the lead of standardization, and so not only given their printed matter a group personality but produced more acceptable forms of time-tables and other literature.

In the specialized fields of book work, school-books and bibles, notable re-stylings have been made by such concerns as Ginn & Company and the university presses. The reader will also have noticed this general trend in new designs for labels, packs, cartons, and so on.

Those kinds of printing which still remain in the hands of the printer have in the main tended to remain static because the printer has chosen to follow the style handed down to him from the last century, and rarely attempted to create more appropriate or up-to-date forms (*vide* country auction bills, posters, handbills, and local press advertising).

The movement in re-designing has now penetrated into most fields of printed work, and to-day new problems of space-economy are arising which will need all the resources and ingenuity of the designer of printed matter to solve satisfactorily.

CHAPTER VIII

PRINTING PROCESSES TO-DAY

(1) Relief

Typographic or relief printing is the most widely used process to-day. Type is composed into lines of even length, by hand, in an oblong three-sided hand-tray of metal (Plate IX) which is called a 'composing stick.' It comprises a base plate with flanges on one side and at the head. An adjustable slide fits flush and is parallel to the side flange, and has a head-piece at right angles and parallel to the head-flange. This slide may be adjusted along the base plate and clamped or locked by a screw or other device. Sticks are made of brass, steel, gun-metal, aluminium, or nickel, and vary in length, 6 in., 8 in. and 10 in. Large sticks made of mahogany are used for setting large types for posters. Some sticks are graduated in points for automatic adjustment.

When the length of the line to which the type is to be set is determined, the compositor adjusts ('makes up') his stick to that measure, which is usually an even number of 12-point ems. He does this by laying the required number of m's of a 12-point type on their sides in the stick, closing the slide up to them and locking it. He then places ('mounts') on the frame the pair of cases, or case, of the type he is going to set.

As the nicks on the front edges of the types make it difficult to move one line of type about on the top of another, he uses a 'setting rule', which is a piece of brass-rule, 3 points thick, with a neb on one side so that it can be lifted up and placed over each line as it is set, and upon which the line being set and spaced can be easily slid.

With the stick made up to the measure, the compositor proceeds to take up each letter from the case, placing it in the left hand corner of the stick with the nick uppermost, and putting a thick (3 to the em) space after each word. The stick is held in the left hand with the open side to the left and with the thumb reaching down to the back (or top) of the stick, which is slightly tilted to facilitate the handling of the types. As each letter is placed into the stick it is received by the thumb. (Plate IX.)

When the line contains as many words as it will take, the compositor either reduces the width of the spaces between the words so

that it will contain another word, divides the word by inserting a hyphen, or inserts wider spaces, to space the line out to the width of the measure. He does this by substituting spaces of different thickness, increasing them from the right or decreasing them from the left. The combinations and their values are as follows:

increase	en and thick	83 per cent. of the em
	thick and middle and thin	78 ,, ,,
	thick and two thins	73 ,, ,,
	two thicks	66 ,, ,,
	thick and middle	58 ,, ,,
	thick and thin	53 ,, ,,
	en	50 ,, ,,
	middle and thin	45 ,, ,,
	two thins	40 ,, ,,
normal	thick	33 ,, ,,
decrease	middle	25 ,, ,,
	thin	20 ,, ,,

The process of adjusting the spacing in a line so that it exactly fills the measure is called 'justification.' Every line is justified to the measure, an incomplete line of words being filled with quads. A line too tight or too loose will prevent even locking-up in the chase, and may result in the types of a loose line or those adjacent to a tight line falling out or being drawn out by the inking rollers of the printing press.

The measure to which type is set should be, ideally, related to the size of the type. Too long a measure will result in the inability of the eye to pick up successive lines, too short a measure will result in gappy spacing and produce channels (or 'rivers') through a page. A good average is ten words to a line, and if this is exceeded the lines are normally spaced by adding leads (pronounced *leds*). Leading is therefore a corrective to type which is a little too small for the measure. Types which have long extruders (descenders and ascenders) give the appearance of leading, and types which are large for their body are usually improved by being leaded.

Word-spacing need only be sufficient to separate the words; newspapers tend to overspace the words (which is inevitable in narrow news columns), and some of the private presses tend to reduce word-spacing to a point of discomfort. Modern practice tends to reduce the full em space after a full stop ('full point' as the printer calls it). The original practice of putting an em space after

a full point doubtless arose from the custom of adding some kind of illumination at the ends of verses in religious texts. The early printers never put a full em space after a full point unless some decoration was to be added by the illuminator. When type setting was paid for at a 'piece rate,' wide spacing and em spaces after sentences naturally helped to increase the rate of pay, and customs die hard in the printing trade.

One of the first things a compositor has to learn is the 'lay of the case' (Plate IX), that is to say, to learn where the various letters are housed. Although there are variations in the arrangement of cases, they follow in the main that which was in current use in the mid-nineteenth century, the last important change (since Joseph Moxon's day) being that occasioned by the abolition of the long 's' in 1787 by John Bell in the *World*.

Type is set in the stick, line by line, until it is full. The type is then taken out and placed on a shallow tray with three sides which are less than the height of the type, called a 'galley.' Galleys are of wood, wood and metal, and wholly metal. They conform generally in size to the sizes of book pages, and are consequently called octavo, quarto, folio. When type is composed in long columns before being made up into pages it is placed on a long column or 'slip galley' of a convenient width. The spacing between lines is usually done when the type is on the galley, and when this is completed the type matter is tied round with a special twine called 'page cord' and a rough proof taken for the proof-corrector to check with the original copy. Corrections to the type are done on the galley or after the type has been slid on to the stone (Plate XII) and 'imposed,' i.e. put into a chase. When an inserted correction or a deletion affects the length of the line, it is necessary to take back or take into the line some words from the next line, and to continue the process to the end of the paragraph. This is called 'over-running.'

Nowadays the greater part of body composition or solid paragraph matter is composed on type-setting machines. In general, Linotype and Intertype machines are used for the composition of newspapers and the Monotype machine for books. The working of these machines has already been described. Corrections to slug composition must be set on the machine, but corrections to matter set on Monotype machines may be made by hand.

The Ludlow machine produces type in sizes from 6 to 72 point in the form of slugs from matrices which are set by hand in a special composing stick. It is mainly used for setting large types for display

work and headings. The matrices are kept in special cases, and the compositor sets them up in the stick, casts them on the machine, and returns them to the case. A companion machine is the Elrod machine which casts leads, blank slugs, and rules.

Types set by hand from foundry type have to be distributed into cases for re-use after the work has been printed. This operation requires extreme care, as type of the wrong size or design in a case greatly hampers the work of the compositor who next uses it for setting. The compositor distributes types by picking up a line or two on a lead with the nicks uppermost, taking a word or two in his right hand and dropping the letters one by one into their appropriate boxes.

Considerable attention has been devoted in recent years to devising a means of composing type without metal, either by photographing it mechanically letter by letter or line by line on light sensitive film or from a prepared copy which is photographed as a complete print.

Reading matter for the letterpress process cannot be composed either as efficiently, as fast, or as cheaply by photographic means, but the photographic principle is eminently applicable to offset and photogravure printing because all that is required for these processes is one good type impression for photographic reproduction. The purpose of the photographic or 'leadless' method of composing is to provide a photographic record only. This record is then printed down on to a plate for printing lithographically. No type or type-casting is therefore necessary.

The first important development in 'leadless' type composition was the Typary machine in 1925, in which raised letters are set from a keyboard, assembled and justified line by line. When the line is completed, it is inked and an impression taken on a roll of Baryta paper, which then moves forward a line. The Orotype machine, a development of the Typary, is similar in principle to the Linotype, and uses raised letters (patrices) instead of matrices, and a printing unit in place of the casting mechanism. It comprises a keyboard, a recording frame, magazine and assembler, inking and printing apparatus, film or paper carrier, line-justifying mechanism, and means for returning the patrices to the magazine. The patrices are assembled as on a Linotype machine, and justified by spring spaces; the lines are transported to the printing unit and locked into position. The lines may be printed on cellophane film or Baryta paper, and the film may be printed on both sides to ensure opacity. Proofs for transferring to lithographic plates are obtained by means

of sensitive photographic papers. Lines which require correction can be removed with benzine and new matter stuck in their place. The speed of composition is roughly the same as on a Linotype machine. The Orotype machine may be regarded as the only machine to have reached the commercial stage for the leadless composition of solid matter. Among the purely photographic devices for composing is the Uhertype, which, however, is only practicable for setting display matter. This machine consists of an apparatus for setting from characters of 18 point in size; a kind of matrix case contains the letters, which are transparent on an opaque ground. There is an automatic focusing camera in the machine which controls the size of the type, and a control for determining the word-spacing. Images are received on roll film, which gives a negative on development of unjustified lines; the spaces between the lines are determined according to the type size and adjusted later as required. In one model used by a well-known London printer there is a flat bed on which the matrix case is moved, the characters being marked on the top of the case in squares which have a white spot. In a thin arm over the bed is a red spot, and the letters are photographed by a pedal action when the two spots coincide. As the matter is composed (in unjustified lines) it is typed on a paper reel on the side of the machine so that the matter may be checked. The justification is effected on a separate machine (after the development of the film, but before corrections are made), each line being rephotographed on a new film in the correct width of line. Matter may be set at a speed of 2,500 to 5,000 characters an hour and justified at twice this speed. The correction of matter composed photographically still forms the greatest problem to its development as a rival to metal types and it is hard to foresee any means whereby corrections could be easily and quickly made.

Whatever method is used to compose the type, it has to be 'made up' into page form. In book-work this is a simple matter; little has to be done by the compositor but the spacing between lines, adding the running headline (if any) and the page number, and carefully checking the depth of each page so that it conforms to the others in the book. The preliminary pages of books (title page, preface, contents, etc.) are the only parts that vary from the standard make-up, although they are, of course, usually in typographic harmony with the text pages. 'Prelims' are usually numbered in roman figures (i, ii, iii, etc.) as distinct from the text pages which are numbered in arabic figures (1, 2, 3, etc.).

In the make-up of text pages certain conventions are observed. No page begins with the last line of a paragraph, nor ends with an incomplete line if it can be avoided; words are not divided at the end of a page; no line is allowed which has less than four characters or which consists only of the rest of a divided word.

In other kinds of work it may be a complex operation to make-up the sections of the copy, set to various lengths and in different sizes of type to fit in with illustrations, so that the whole will form a compact unit.

The iron frames in which type matter is clamped for transport and for machining on the press are called chases. Chases are of various sizes and are named after the sub-divisions of paper sizes: octavo, quarto, etc. When a set of four, eight, or more book pages is required to be held in the same chase, it is strengthened by the addition of movable cross bars (Plate X) running across the length and width.

When the type is locked into a chase the whole unit is called a 'forme'; when formes of bookwork are too cumbersome to be made up ('imposed') in one unit, the pages are locked into a pair of chases called 'bookwork folding chases,' which fit close together on the machine to serve the same purpose as one very large chase.

There are also chases to fit the smaller platen printing machines. When an area of type matter is very small it is locked up in a small chase, and the small chase is then locked up in a larger one.

To secure the pages in the chase, furniture and quoins are used. A special kind of furniture in the form of a long wedge is used between the type matter and two edges of the chase, and small wedge-shaped pieces of wood (wooden quoins) are used to tighten up the forme by being forced along with a mallet and a tool called a shooting-stick. This operation causes a considerable noise, and is now largely superseded by the use of mechanical metal quoins which exert a direct lateral squeeze and need no wedged furniture.

Before the quoins are tightened in a forme the type is levelled by a flat oblong piece of hard wood called a planer. This is placed on the surface of the type and two or three taps given to ensure that all the types are down to the same level.

Imposition consists of arranging the position of the page in a chase and determining these positions by the use of furniture, quoins, etc. The term is also used generally in the sense of locking up any type matter or blocks in a chase. Imposition is done on a 'stone,' a table on which a plate of iron (in earlier days a slab of

stone) is mounted which forms the imposing surface. Formes which print more than one page are of two kinds: those which are used for printing both sides of the paper identically, and those which are used for printing one side only, the other side being printed with a different forme.

In the first case, after being printed on one side the sheet is turned over, fed into the machine at the opposite edge, and printed with the same forme. The sheet is then cut in half and gives two perfect and complete copies.

In the second case the sheet, after printing each side with a different forme, gives only one complete copy. The two formes are called 'inner' and 'outer,' and this refers to the folding. The principle will be appreciated by reference to Plate XII.

Books are normally printed in sections of 4, 8, 16, 32, etc., pages. Each of these sections is given a letter or number which is called its *signature* and is printed at the foot of the first page of each section. This letter gives the name to the forme (such as 'B' outer or 'B2' inner), and the compositor refers to the forme and identifies it by this number; the machine-man looks for the signature as a guide when positioning the forme on the printing press; the folder uses the signature to determine how the sheet is to be folded; and the collator or bookbinder determines the order of the sheets for binding by reference to the signature.

When subsequent reprintings are likely to be required, a cast is made from the type pages. Flong moulds and stereotypes take up less storage room than type, and allow the type to be distributed into the cases or melted down. They also allow large editions to be printed more quickly, as the type may be set, several steroes made, and several impressions printed on a large sheet which is subsequently cut into units. Thus by printing two-up, four-up, eight-up, etc., the number of impressions on the printing machine is reduced by half, a quarter, or an eighth. Matrices are also used for duplicating newspaper pages (which are usually printed from curved stereotyped plates), and this enables many editions and copies to be printed in a short time. The stereotype matrix is also a convenient method of duplicating advertisements, and enables the advertising agent to insert the same advertisement on the same day in several newspapers up and down the country merely by sending flong matrices through the post.

The papier mâché process allows as many casts to be made as are necessary. The mould is made from flong (a material consisting of

several thicknesses of paper of various kinds cemented together with a paste compounded of such substances as flour, starch, glue, dextrine, whiting, and water). This moist flong is beaten into the forme and the larger hollows filled with pieces of card. The flong, now called a matrix, is dried and is then placed in a casting-box and lowered into a pot of molten metal (5–10 per cent. tin, 15–19 per cent. antimony, rest lead) and allowed to remain until no more bubbles rise to the surface. After casting, the box is cooled with cold water, the metal cast is removed, planed, bevelled, and mounted on wood or metal, so that it is of the same height as type. This method provides a stereotype which takes fine detail, which is flat, free from airholes, and perfectly solid.

The dry flong method is now used in newspaper offices. The flong (which consists of a base material sometimes coated with a chalk-like composition) is laid on the forme and run through a 'mangle' or under a direct-pressure moulding press; no heating, beating or drying is required. The mould (or matrix) is then placed in a casting machine which casts a curved stereotype, ready for the press cylinders, in one operation. These casting machines cast the plate, trim away superfluous metal, bevel the ends, plane the sides, shave the interior of the plates to correct thickness, cool, and dry them at rates up to four a minute. The Dalziel process of stereotyping uses a form of plaster mould which, it is understood, gives a good face to the casts.

Stereotypes are also made of rubber. Moulding is effected from a flong matrix with uncured rubber (treated with sulphur to avoid subsequent stretch by heat). Stereos are made from synthetic resin moulds from type formes. The 'Palaplate' is made from a bakelite matrix in an electrically-heated moulding press and cast in a similar material. Bakelite has the advantage of being light in weight, non-metallic and therefore non-corrosive, it has no grain, it is not easily scratched, abraded or otherwise damaged, it has a greater affinity for printing ink than metal and so effects a reduction in ink consumption, and with fair treatment will outlast ordinary stereos or electros.

A more faithful duplicate is made by electrotyping, a process of duplicating a typographic surface by producing a metallic copy by means of depositing copper upon a wax mould by electrolytic action. The forme is impressed, in a moulding press, into a moulding case containing wax, both surfaces of which are blackleaded. The moulding case is then released from the forme, an the impression so formed is built up by running melted wax on to those parts which correspond to

the blanks in the forme. The mould is then blackleaded (to give it an electrically conductive surface) in a machine with vibrating brushes, rinsed and dried. It is then coated with sulphate of copper and iron filings, washed, and placed in a copper-depositing tank. When a sufficient thickness of copper has been deposited, the shell is removed from the wax, treated with soldering flux and tin foil, reinforced with stereotype metal, and mounted on a wood or metal base.

An improved method, known as the silvering process, of producing electrotypes from wax moulds has been invented and developed in the laboratories of The Printing and Allied Trades Research Association. In this process the wax mould is made as usual, but French chalk replaces blacklead as a separating agent. This is an advantage, for blacklead is dirty to handle and its low electrical conductivity prevents rapid and uniform electro-deposition of metal to form the shell. Soft brushing and an air blast removes loose chalk from the mould, which is then brushed over with a wetting agent. This agent prepares the wax for the next step in the process. After being rinsed in water, the mould is set up in a spraying booth and sprayed simultaneously with a solution of ammoniacal silver nitrate in water and a solution of formaldehyde in water. This treatment rapidly builds up a coating of metallic silver on the mould.

Finally, the mould is washed and placed in a depositing bath, where a copper shell grows over it in about one-tenth of the time taken with the normal graphited mould. This new process is available under licence only to members of P.A.T.R.A.

Duplicate plates are often nickel-plated or chromium-faced to give extra durability; a chromium-surfaced block gives about five times as much wear as ordinary stereo plates. For fine half-tone illustrations, lead moulds instead of wax are used in a hydraulic press.

The plates from which almost all pictures and drawings are reproduced for letterpress are made by photographic methods, the subject being etched on metal.

There are two kinds of photo-engravings: line and half-tone. Line blocks are usually made of zinc and half-tone blocks of copper.

Line engravings are used for the reproduction of illustrations in black and white (solid black designs on a white ground) and are normally made from a black and white drawing in indian ink on bristol-board. Line engravings are also made from scraper-board originals. This board is coated with a thick layer of china clay and size upon which indian ink can be drawn or brushed, and scratched away with a knife. It is widely used for pseudo wood engraving

effects, in which case it is completely covered with indian ink and then scraped away where required.

Every part of a drawing for the line process must be of a solid colour and not a tone or shade of it, although drawings on rough or grained paper will reproduce well. In any case there must be a strong contrast between the ground and the lines and masses of the drawing. Light and shade may, of course, be simulated by varying the thickness of the lines or the distance between them or by the use of mechanical tints (see illustrations on p. 97 and p. 100). The drawing should be about twice the size of the intended engraving.

The drawing is placed on a board in front of a special camera (which can take plates 10 in. × 8 in. or any size up to 40 in. × 30 in.). The frame of the camera is usually made of steel tubing mounted with springs to eliminate vibration. The copy is illuminated with powerful arc lamps, and the image on the ground glass at the back of the camera focused to the size of the engraving required (Plate XIII). For line work wet collodion plates are still widely used. A piece of glass is cleaned, coated with albumen and dried. It is then coated with iodized collodion and allowed to set, and dipped in a light-proof tank of silver nitrate for a few minutes so that silver iodide is formed on the collodion. The plate is now sensitive to light and is placed in the plate-holder in the dark room. This wet plate gives a negative of great contrast. It requires about eight times more exposure than a slow dry plate, but development, fixing, cleaning, and intensification are quick. The negative when made can also be dried by heat.

After the plate is developed, fixed, and intensified, it is coated with rubber solution, dried, and coated with collodion. The negative is then cut, soaked in acetic acid and stripped off the glass. Very few original copies require exactly the same reduction in size and negatives are made separately. This stripping is done so that several subjects may be etched on the same zinc plate together, the stripped film being placed with a number of others on a sheet of ¼-in. plate glass.

Dry plates of special characteristics are now increasingly used for this work. A piece of zinc ·065 in. thick is cleaned and rubbed with pumice powder and water to obtain a matt surface for a coating of ammonium bichromate and albumen, which is spread on the zinc plate in a film and dried over heat in the dark room.

The metal surface is now sensitive to light, and the bichromated film will become hard and insoluble in water on exposure to light. When the coating is dry the negatives on the plate glass are placed in contact with the sensitized surface of the zinc plate in a special

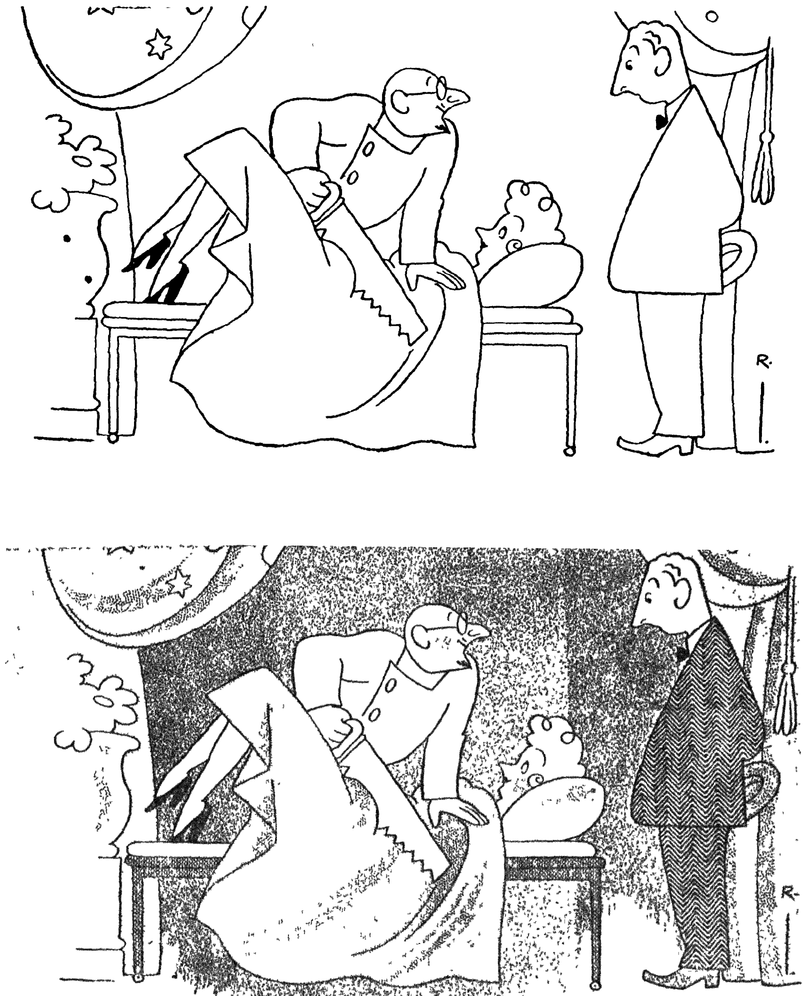


FIG. 48.
Line engraving with and without mechanical Ben Day tints.

FIG. 49.

Showing various treatments of the same illustration in photo-mechanical line engraving: pure line, black-and-white, scraper board, and crayon

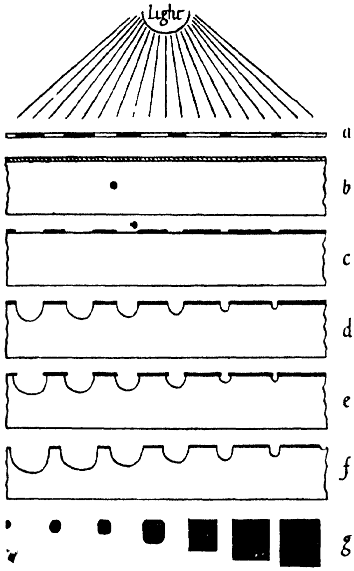
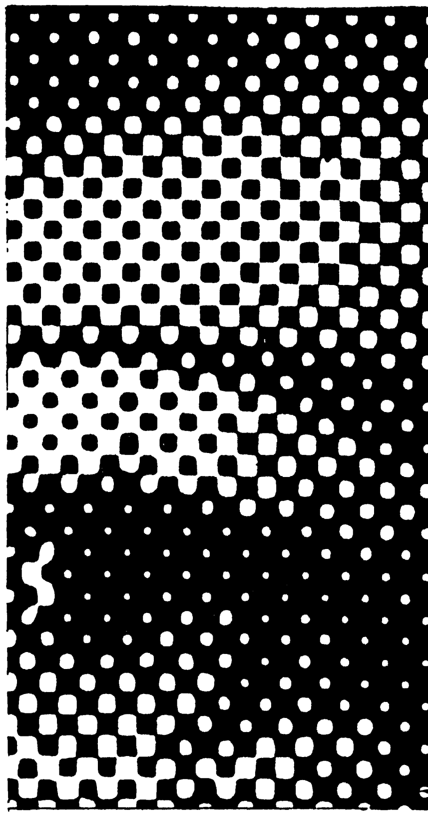


FIG. 50.

Stages in the making of a half-tone engraving.

(*a*) Negative.
(*b*) Metal coated with bichromate.
(*c*) Metal after printing down, showing the half-tone dots in the enamel acid-resist.
(*d*) Half-tone dots after slight etching.
(*e*) Half-tone dots after continued etching, showing the undercutting action of the acid and a part of the acid-resist projecting beyond the metal.
(*f*) After further etching, showing the breaking away of the projecting resist.
(*g*) Impression from the finished half-tone engraving, showing the reduction in the size of the dots.

[*After Smith, Turner & Hallam.*]



(*Above*) Portion of half-tone engraving, much enlarged.

printing frame from which all air can be extracted to form a vaccuum to ensure close contact. The frame is now exposed to the light of powerful arc lamps for a few minutes.

The zinc plate is then taken out of the printing frame, laid on a slab, and rolled with a leather roller with a special ink. The plate is then washed under a faucet of running water and gently rubbed with a wad of cotton wool.

The parts of the negative which were transparent allowed the light to act upon the bichromated film on the zinc and rendered it insoluble in water. The parts of the surface which were protected by the opaque parts of the negative remain soluble and are dissolved by the action of water.

The zinc plate is now warmed, which makes the ink tacky, and dusted with a brown resinous powder called bitumen which adheres to the tacky ink. The plate is again warmed to melt the resin, which forms an acid resist on the parts which form the design.

The plate is then placed in an etching bath of dilute nitric acid, which eats away the unprotected parts of the metal. Etching is usually done in a machine where the plate is fixed at the top of an enclosed tank and acid dashed upon it by motor-driven paddles. The acid resist protects only the top surface of the zinc, and in order to avoid undercutting, the plate is taken out, washed and dried, dusted with dilute nitric acid, known in the trade as dragon's blood (and heated to melt it), between subsequent etchings, the dragon's blood being brushed close up and melted against the etched sides of the lines each time in four directions by four separate dusting, melting, and cooling operations. Times of etching are about half-a-minute, 1½ minutes, 3 minutes, 8 minutes.

The acid-resist top is then removed with hot lye or potash and methylated spirits. The plate, on examination, now shows a series of terraces formed by the etchings. The plate is therefore again rolled with a stiff waxy ink and returned to a weak etching bath to smooth the shoulders or terraces.

The larger etched-away portions of the plate are now cut away ('routed'), and other spaces deepened; a proof is taken, and if satisfactory, the plate is mounted, usually on wood, to the height of type (·918 in.).

Patternings called tints are sometimes applied to line drawings. The tints are placed on the zinc after the image has been printed down. The parts of the zinc which are not to be tinted are painted out with gum and dried. The special gelatine film, which has the

pattern or design of tint in relief on one side, is inked and placed in contact with the part of the zinc to be treated, and the ink on the pattern is transferred by pressure. The gum is washed away and the plate is dusted with bitumen powder while the ink is tacky; heating then melts the resin which forms an acid resist. Several patterns may be introduced on the same engraving. (See Fig. 48.) Some of the various methods of treating the same subject for reproduction by line engraving are shown in Fig. 49.

The half-tone engraving is used to reproduce illustrations where the effect of continuous tones is desired. In relief printing all the ink must be deposited on the paper from solid surfaces of the same height. The illusion of intermediate tones is therefore produced by breaking up the image (by the use of a cross-line screen) into equally spaced dots of varying size to give the effect of continuity of tones. Each dot prints a solid black (Fig. 50).

The cross-line screen is adjusted immediately in front of the negative in the camera. It consists of two pieces of plate glass, each of which is engraved with parallel lines filled with opaque pigment, cemented together so that the lines are at right angles. The lines and the clear space between them are equal in width. The lines may vary from 45 to 225 to the square inch according to the smoothness of the surface of the paper to be used; rougher papers require more open rulings, as the interstices between the dots would fill up and result in a muddy print. (Plates X and XI.)

The 'copy' for a half-tone engraving is usually a photograph, and a good black-and-white glossy bromide print with wide gradation of tones reproduces most successfully. Other suitable 'copy' includes monochrome drawings in oil or water-colour and purple-toned P.O.P. prints; difficult 'copy' includes rough photograph prints, steel and wood engravings, half-tone, sepia-toned and carbon prints.

Photographs are often retouched with a suitable wash to emphasize outlines, to increase shadows or high lights, or to paint out unrequired parts. A print twice the size of the engraving required is also desirable as it is more convenient for the retoucher to work on, and it minimizes slight defects, in the resultant engraving.

Methods have recently been introduced for fluorescing copy in photo-engraving for high-lighting half-tone engravings. Fluorescence is the property of certain substances to become self-luminous when exposed to the action of ultra-violet light rays.

For black-and-white photographs, wet plates are used for making the negative, and the image is reversed left to right, laterally transposed,

by means of a prism on the front of the camera, so that the finished printing will be the correct way round.

When the exposure is made (with the diagonal cross-line screen in front of the plate) a series of dots is produced on the negative. Different amounts of light which, under the correct conditions, spread and determine the size of the equidistant dots according to the intensity of light received, pass through the screen openings according to the brightness of the copy.

Two exposures (or sometimes three) are made. The last exposure is a 'flash,' made by covering the copy with a sheet of white paper and with a small stop in the lens; this ensures that the small isolated dots in the negative (representing the shadows in the copy) have a firm centre. For exposing the copy, a small stop is used for the shadows and a larger one for the high lights.

A number of special screens are occasionally used. The vertical screen is merely the ordinary screen used so that the lines are vertical and horizontal instead of diagonal. The one-way screen has lines ruled one way only and is effective in architectural subjects. There are also curved one-way screens which give roundness to certain subjects, linen screens which give a linen texture, and the irregular Erwin screen which gives a grained effect.

After exposure the plate is developed and fixed. The negative is then intensified to give complete opacity in the smallest dots (those representing the shadows of the copy) and to join the corners of the high-light dots. It is then reduced or 'cut' to reduce the shadow dots to the smallest size to retain the depth of the original.

Half-tone engravings are made on zinc for the coarser screens and on copper for finer screens. The metal is cleaned as in line engraving, but fish glue mixed with ammonium bichromate is the sensitized coating. The metal is now exposed under the negative as in line engraving, but the metal is not inked; the image is treated with a solution of strong aniline dye which stains the fish glue and clearly shows up the image after washing. The plate is now 'burned in' with heat to turn the bichromated fish glue into an acid-resist.

At this stage, dots are sometimes made good by painting in; parts of the image to be solid black are painted out, and parts to be white are scraped bare, border lines (if required) are added, and so on.

The plate is etched, nitric acid being used for zinc and perchloride of iron for copper.

Recently a cold top enamel has been introduced which requires no burning in but may be subjected to moderate heating if required.

It is a strong and tough resist, and may be used for copper or zinc. Burning in tends to warp, melt and reduce the hardness of metals, and in the case of zinc, which when heated undergoes a crystalline change, softens the metal, and causes a rough granular result in the etching.

Etching may be done in porcelain dishes or in an etching machine, or electrolytically. Ammonium chloride with sodium chloride is used in the electrolytic bath.

During re-etchings the plate is carefully painted over the shadows of the image with acid resist and etched, and the small dots become smaller, so heightening the contrast (see Fig. 50). After etching, the plate may be hand-engraved with a fine graver. It is then bevelled to take the nails for mounting and mounted on wood or metal as with a line engraving.

Half-tone engravings may be given various finishes, such as squared-up with or without a line around them; cut into circles, ovals or other shapes; vignetted (gradually fading away at the edges); or cut-out so that there is no screen background. Deep-etching means etching away high-light dots altogether; deep half-tone means etched to extra depth, a kind of half-tone that allows a slightly rougher paper to be used than would otherwise be possible.

Line and half-tone are sometimes combined. Two negatives are made and combined on the plate before etching.

All printing plates may be divided into two groups: originals and duplicates. Half-tones may be duplicated to avoid the cost of re-engraving when they are worn out. Duplicate half-tones may be made by the engraver at the same time as the original; more usually stereotype (if the screen is wide), electrotype, or plastic duplicates are used.

Although newspapers are normally printed from stereotypes, newsprinting is now being done from directly engraved line and half-tone blocks, notably in America for supplements and special editions. In the Alltone plate, the entire area bears a half-tone dot-formation, more or less normal in the half-tone images proper, but in the form of a high-light tint or small relief dots in the areas devoted to type matter. This dot formation serves as a bearer for the inking rollers. In these processes thin zinc plates are used and bent around the press cylinders on suitable mounts.

CHAPTER IX

PRINTING PROCESSES TO-DAY

(2) Lithographic

THE method of drawing direct or transferring designs on lithographic stones has already been described in Chapter V. The substitution of metal plates and the application of photography has considerably widened the scope and increased the printing speed of Senefelder's original invention. The introduction of metal plates with grained surfaces has largely superseded the cumbersome stone, and the plates may be curved to fit the cylinders of rotary machines, thus enabling high printing speeds to be attained. Nevertheless, the use of the stone persists for several kinds of work.

Lithography is widely used for large posters drawn direct on to the metal. Posters may be produced photographically by the projected enlargement of screen negatives and positives, although this method is not in general use.

Photo-lithography was developed from the use of a photographic negative printed down on a sensitized stone and printed on a flat-bed press. To-day, in addition to zinc and aluminium, stainless steel is being used, which enables more impressions to be made without any appreciable deterioration in the printing quality or difficulties arising from grained aluminium or zinc. The initial cost, of course, is higher, and the rigidity of stainless steel complicates the fitting of the plate around the machine cylinder and its flattening after use.

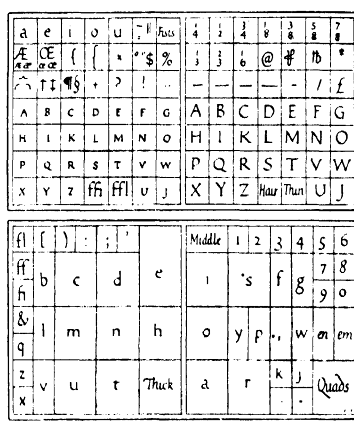
Messrs. Kodak Ltd. have introduced a sensitized metal plate for photo-litho use. These 'Silvalith' zinc plates consist of grained litho zinc coated with a silver emulsion (instead of the usual bichromated albumen), and may be exposed to either a negative or positive in the camera or by contact, and converted by a simple processing technique into printing plates, thus avoiding the need for an intermediate negative. The process is not in general use.

Practically any kind of copy may be used for photo-lithography; wash drawings (where there is a wide range of tones), line work in combination with wash drawings, stipples and other textures (such as spatter work, linen effects, and so on), photographs, and type matter provide suitable copy.

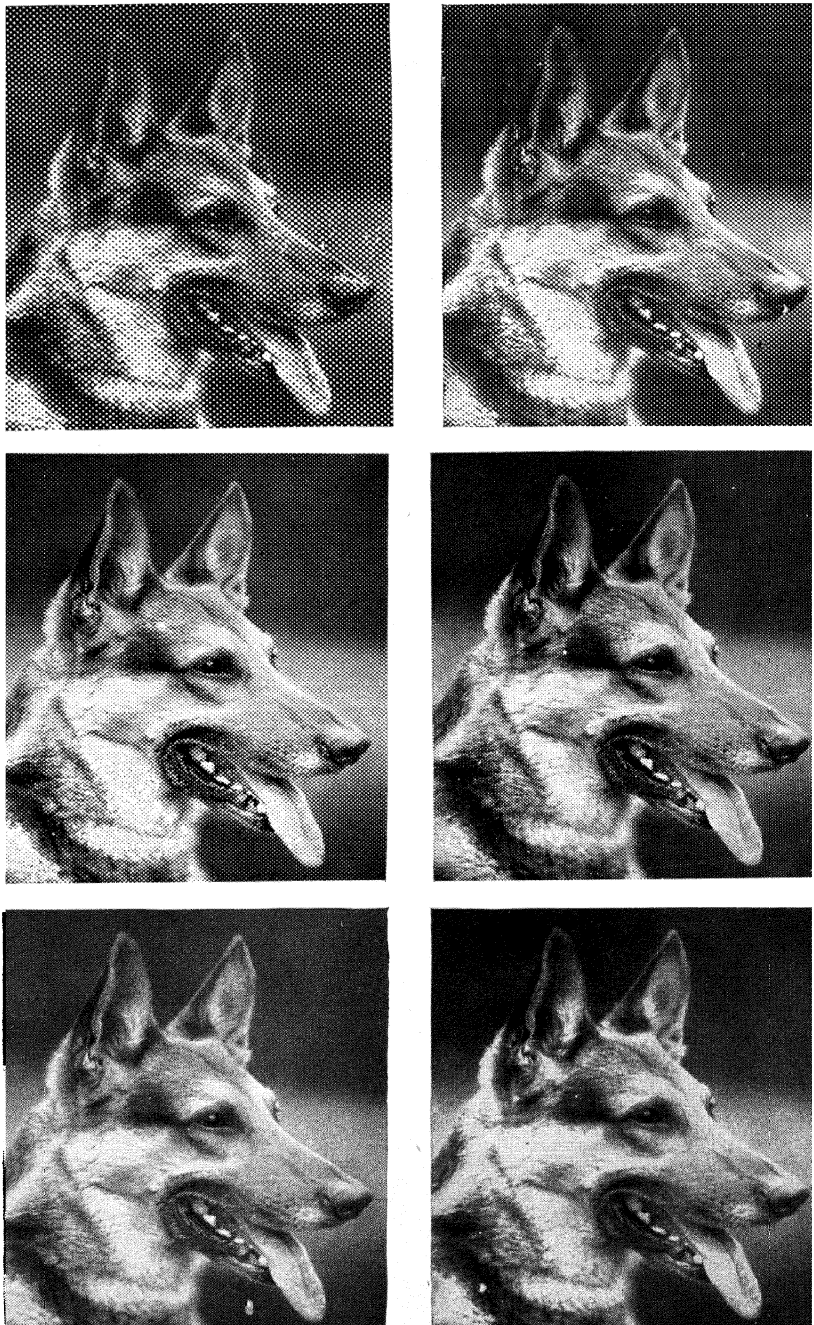
Negatives or positives for the process are made in a similar way,

A modern composing-room at the Sun Engraving Works, Watford.

COMPOSITOR AT WORK.

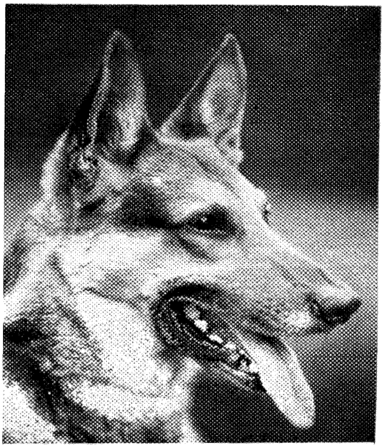
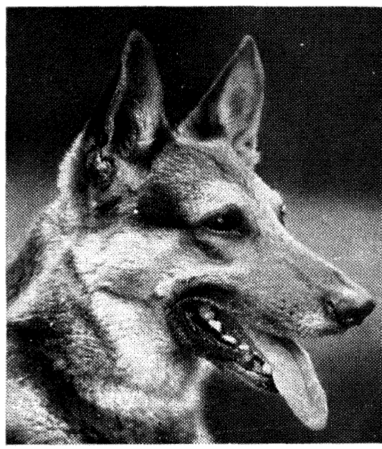
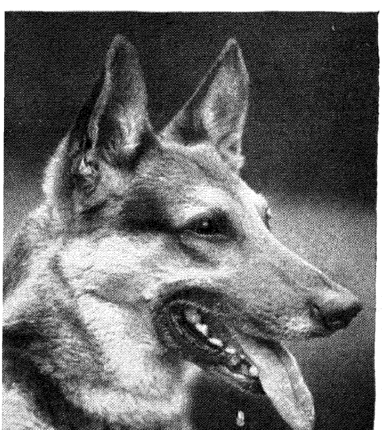
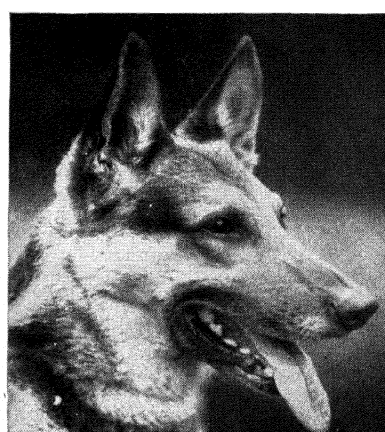


The lay of the case as recommended by John Southward, the late nineteenth century authority whose works have greatly influenced present-day printing practice. It is derived from the lays of John Johnson (*Typographia*, 1824), and William Savage (*Dictionary of the Art of Printing*, 1841). The top left-hand row of boxes house the standard accents (grave, acute, circumflex, and diæresis or umlaut).



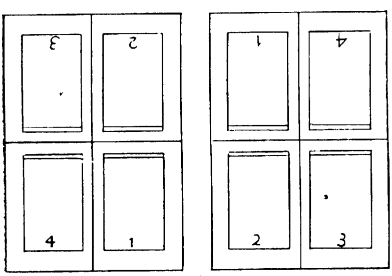
[illegible] 65, 85, 100 and 110 rulings to the inch



Compositor with locked-up forme, ready for the press. Note the mallet and shooting stick (used for locking up the quoins) and the planer for levelling the type before the forme is locked up.

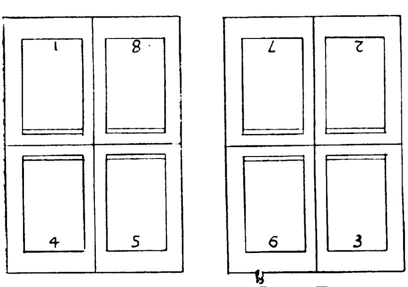
HALF-SHEET WORK : Work and turn



First printing

Second printing (same forme)

SHEET-WORK : Work and back



Outer Forme (First printing)

Inner Forme (Second printing)

The diagram illustrates methods of imposition. (*Above*) Imposition of a 4-page folder. One side of the paper is printed, the paper is then turned over and printed with the *same* forme. The sheet is then cut along its breadth, each sheet making two complete copies. (*Below*) One side of the paper is printed with the 'outer forme' and the other side with the 'inner forme.' Thus two separate formes are used. Folding gives one copy of eight pages.

both for line and continuous tone subjects, to that described for process engraving. Both wet and dry plates are used. For reproducing subjects in gradation the highlights need to be almost joined and the shadow dots larger than in process engraving, as there is no etching on the photo-litho plate and the dot formation must be represented in correct tonal dot value. In engraving for letterpress printing, allowance must be made for the raising of tone during etching.

Films and paper negatives are often used for the reproduction of book pages. Paper negatives are less costly and are either translucent or can be made so with oil. In the 'Reflex' processes a paper positive is made by exposure through a sensitized paper placed in contact with printed matter. From this print (a positive paper) a stripping paper (in effect, a film negative with a temporary paper backing) is used to print down on to the metal plate.

Wet plates are usually intensified after development, but this is not generally necessary with modern dry plates of steep gradation unless the subject is difficult or there has been some misjudgment of exposure or development. Wet plates do not lend themselves to considerable retouching, and no work other than spotting is done. As the negatives are normally made from retouched monochrome originals or pictures, hand work is not usually necessary. Dry plate negatives are often modified by reduction, intensification, and retouching. This is necessary as no work can be done on the finished metal plate after it is printed down; the negative must be as correct as possible. In modern photo-lithography tonal corrections are made by dot etching.

In photo-litho irregular grain effects produced photographically are sometimes employed, canvas effects are also produced by the use of irregular iron gauze or silk instead of the normal screen.

Tints are added either as a black patterning on white areas or white stipple on solids by using shading mediums on the negative or the litho metal plate; there is also a method that enables impressions in black or white to be transferred to the copy, and allows their effect to be assessed before photographing. The tints may be removed and replaced without injuring the copy.

When a negative is required consisting of several repeats of the same subject it may be done on a step-and-repeat machine, which projects a master negative or transparency on to a sensitive film and, by means of fine control adjustments, the film is moved to predetermined positions so that a negative is obtained consisting of a large number of smaller negatives all in correct position. Step-and-repeat and

printing-down machines are also used to print down direct on to the litho metal plate without the need of 'compound' negatives. These machines are largely used for multi-negatives for stamps, labels, cheque background and other repetitive patterns.

The photo-litho plate is grained in a similar way to stone, and importance must be paid to the nature of the surface produced; plates already grained in various textures are available from supply houses. The plate is coated with a bichromated film, and a whirling and drying machine is used to spread and dry the coating evenly. The damping is not sufficient to affect the paper.

The negatives are printed down on to the metal in vacuum frames of various types, even illumination being very important. The metal plate is then inked with a tenacious ink, developed under a jet of water until the image appears sharp and clean, and dried. Slight spotting or other work with litho chalk or ink may be done at this stage when necessary. The image is then made ready for the machine by a modified litho treatment.

The kinds of lithography already described are known as 'direct lithography', implying that impressions are made by direct contact of the paper with the lithographic stone or plate. The design on the stone or plate is therefore the reverse of the printed impression as in letterpress printing. 'Offset' lithography is not printed direct on to the paper, but upon a cylinder covered with a rubber 'blanket.' The paper is then pressed into contact with the impression on the rubber blanket, thus 'offsetting' the impression on to the paper. This double reversal requires the design on the stone or plate to be the same way as the final printing and not reversed as in process block-making.

Offset, including photo-offset enables a much wider range of papers to be used than is possible with letterpress half-tone blocks (which usually require coated or 'art' paper); the plates are cheaper than photogravure plates or cylinders; and the results give softness of impression and delicate blending of colours. In addition the resilience of the rubber blanket permits light pressure for the impression, far less ink is required, and long runs show no appreciable deterioration in printing quality as with letterpress printing. There is the disadvantage that the rubber blanket is unable to transfer more than a limited quantity of ink, although offset inks are being rapidly improved to give density of colour, and the practice of slightly etching the plates, 'deep etch,' is giving finer quality and depth without spreading. This scarcely measurable intaglio effect also gives some

protection to the image from the friction of the damping and inking rollers, but it does not prevent the grain from wearing out.

The offset process was used for printing on metal for subsequent enamelling about 1880 and applied to printing on paper about 1904.

There is no radical difference in preparing plates, whether for flat-bed or rotary printing, between photo-litho and photo-litho-offset except that the image must be reversed for offset printing. A prism is used in the camera (which will cause the image to be laterally reversed) for making either negatives for contact positives or plates from a reversed original. Such originals may have to be used where original litho stones or plates have been in use for making offset plates; a laterally reversed printing surface is needed for direct lithography, but an unreversed one is required for offset lithography as the impression is offset from the blanket cylinder.

In certain kinds of work photo-offset plates are made by direct printing from a paper print, for example, which obviates the necessity for a negative and ensures that the image on the plate is exactly the same size as the original, which may be a drawing on translucent paper or on any paper which will pass sufficient light.

It is possible to print a continuous tone photographic negative direct on offset plates without a screen, gradations of tone values being controlled by manipulation of the albumen image over the plate grain and permitting the grain of the plate to show through in the lighter tones with a similar effect to that of collotype. This method, however, has a limited use.

Another development forecasts the abolition of the water-fountain and roller-dampening methods in lithography by the 'isolith' method. This method involves cooling the plate cylinder with refrigerants and blowing warm moisture-laden air over the surface. The moisture condenses and is absorbed by the metal in the ink-repelling areas. It is said that the method should result in richer tone quality by avoiding water emulsification of the ink with its consequent loss of values.

Bimetallic plates are used in the Aller process employed for the *Familie Journal* at Copenhagen. The metals used are stainless steel, chromium, or chromium alloy with a deposit of copper, nickel, or copper over nickel. The image is printed down and etched to remove the deposit and to leave the steel exposed. The deposit attracts ink; the steel repels it. As the image is of metal it is more permanent than the chemical image on an ordinary litho metal plate. As the bimetallic surface is not grained, all the screen dots are

perfectly sharp, there being no grain to interfere with their shape, Another advantage of this plate is that it is easier to keep the dampened areas free from ink. The *Familie Journal* is printed on a rotary offset press from such plates at a speed of 10,000 an hour.

A method of dry lithography called Pantone was introduced in 1926. A plate of iron or suitable metal is copper plated and on this plating is deposited chromium $\frac{1}{10000}$ in. thick. The image is printed down photographically as in process engraving and the plate etched in hydrochloric acid (which etches the design in the chromium down to the copper, which is not affected). This gives a plate with the design standing out in chromium on a copper ground. The plate is then given a thin silver plating which is accepted by the copper only, the chromium parts not being affected. The plate is then rubbed over with mercury, which is accepted by the silver surface and rejected by the chromium surface. The printing surface is therefore chromium and the non-printing surface silver-mercury amalgam. The plate may now be used to print from on an ordinary letterpress machine (with type, if desired). By employing a printing ink into which a compound of mercury is incorporated the amalgam is fed with mercury and is not removed by attrition; it thus retains its ink-resisting property. The ink is rejected by the silvered parts, but accepted readily by the chromiumed parts.

Collotype was not used commercially until about 1890; the first Medici prints date from 1898. It is a planograph photographic method of printing which uses a film of light-hardened gelatine adhering to a glass support (instead of a stone or plate). No screen is used. It depends on the reticulative property of bichromated light-hardened gelatine for its tone gradations. A reversed negative is used, and from it a print is made on a film of bichromated gelatine on a glass support by exposure to light. The light makes the bichromated surface impervious to moisture in direct ratio to the light and shade of the negative; the parts most affected become most moisture-resistant. The plate is washed in water to remove the free bichromate, and the soluble parts of the gelatine absorb water and swell while the insoluble parts remain slightly lower, the depth varying according to the tones. The plate is prepared for printing by treatment with a glycerine, ammonia, and water solution. The glycerine increases the moisture-retaining properties of the soluble gelatine, and this treatment is repeated during printing. When the plate is inked, ink is received in inverse proportion to the moisture retained, so that the moistened parts

repel the ink and the soluble parts accept it. Printing is effected on a hand press similar to that used for direct lithography or on a flat-bed machine similar to the kind used for lithography.

Collotype is used for reproducing fine illustrations where absolute fidelity is required, and is mainly confined to small editions. Efforts have been made to use the process more extensively by hardening the film bearing the image and so prolonging the life of the plate. The process has been adapted for rotary printing by preparing the image on metal or film instead of glass, and also by using a transfer on metal from the original collotype film. Such methods allow the plate to be curved around the press cylinder and printed on suitable rotary machines.

It is in colour work that this process excels, particularly in the reproduction of works of art in which seven or eight printings in colour give a richness and quality of tonal fidelity that can be rendered by no other printing process.

The Aquatone process has been developed in America from collotype by the use of thin zinc plates coated with bichromated gelatine and black-and-white or half-tone negatives. The principal difference between this process and collotype is that the gelatine is not reticulated and the half-tone principle is used.

CHAPTER X

PRINTING PROCESSES TO-DAY

(3) Photogravure

Photogravure is a photo-mechanical method of etching a copper plate in intaglio and taking prints from the recesses or sunken parts in which layers of ink of different depths, held between the recesses in the plate, are capable of being delivered in their relative quantities at one impression, so giving a reproduction of the full tonal depth and detail of the original photograph.

Hand photogravure is printed from a flat copper plate; machine photogravure or rotogravure is printed from a cylinder coated with copper or thin copper plate affixed to the impression cylinder.

Rotogravure was first developed about 1895 by the Rembrandt Intaglio Printing Company from a process perfected by Karl Klič.

Hand or grain photogravure requires but little plant beyond a dusting box and a copper-plate press, is simple but individualistic, and depends largely on the skill of the craftsman.

A suitable positive is made from a negative, printed on a paper called carbon tissue which has been coated with pigmented gelatine and made sensitive to light by immersion in potassium bichromate.

A copper plate is grained by stirring up powdered bitumen (either by a fan or rotating brush) in a box, allowing it to settle on the surface of the plate, and fixing it there by heat. This grain later forms the cavities or depressions which hold the printing ink and prevent it being wiped out of the etched portions during inking up for printing.

The carbon tissue, after the positive has been exposed on it, is transferred to the grained plate and, after removing the paper support, is developed in hot water, which washes away the soluble gelatine in proportion to the effect of the light exposed to it. Light hardens the gelatine and so forms a resist to the action of the etching which now follows. The high lights are represented as the thickest parts of the resist, middle tones are of less thickness, thus allowing the etching solution to enter more deeply into the plate, and the dark tones consist of a thin layer of gelatine, allowing greatest depth of etching.

In hand printing the plate is covered with a 'short' ink and the

surface wiped clean. The copper plate hand-press used exerts great pressure, so that when the paper is removed from the plate it pulls the ink away with it from the etched or depressed parts; thus the tones of the original are represented by ink films of varying thickness. The plate may be revised to a considerable extent by subsequent controlled etching. Prints usually show a plate-mark impression which distinguishes them from machine gravure. Hard papers may be used if they are dampened before printing. Hand photogravure is within the capabilities of the skilled amateur photographer.

Machine photogravure is printed from cylinders or thin sheets of copper on sheet-fed or rotary power-presses. No grain is laid on the plate, but in its place a cross-line screen is used. This screen is quite different from that used in making a half-tone engraving. Instead of having opaque lines on the glass, the lines are transparent, the intervening squares being opaque. The screen therefore forms an insoluble network of lines over the picture in the acid-resist. This screen does not build up the picture as in the half-tone process but forms pits to hold the ink during printing. This grid of fine-crossed lines (Plate XIV), which are even in width over the whole print (see Plate II), is a characteristic quality by which machine photogravure may be identified.

The first stage in the process is to make negatives from the copy supplied, usually one for the line parts and one for the continuous tones. Bromide prints may be made at this stage as proofs to guide the compositor as to the areas to which type matter is to be set. When the type is set, proofs are taken on a thin onion-skin paper with special ink which is dusted with finest bronze powder. The powder adheres to the inked impression and gives greater density. Alternatively the type-forme may be sprayed with a deep black matt varnish, the type surface polished so that it stands out brightly against the black background, and a photograph made from it. In this way no ink squeeze shows on the finished negative, and as the type is in reverse it gives an image ready for immediate printing down.

The negatives of the line and continuous tone portions are passed to the retoucher, who paints out the tone on one and the line on the other. High-lights are improved, spots and faults corrected, and the negatives returned for positives to be made from them. These positives are sometimes retouched and then passed to the planning department.

The positives are treated with a coating of collodion to thicken the film and they are then stripped off the glass support; the line,

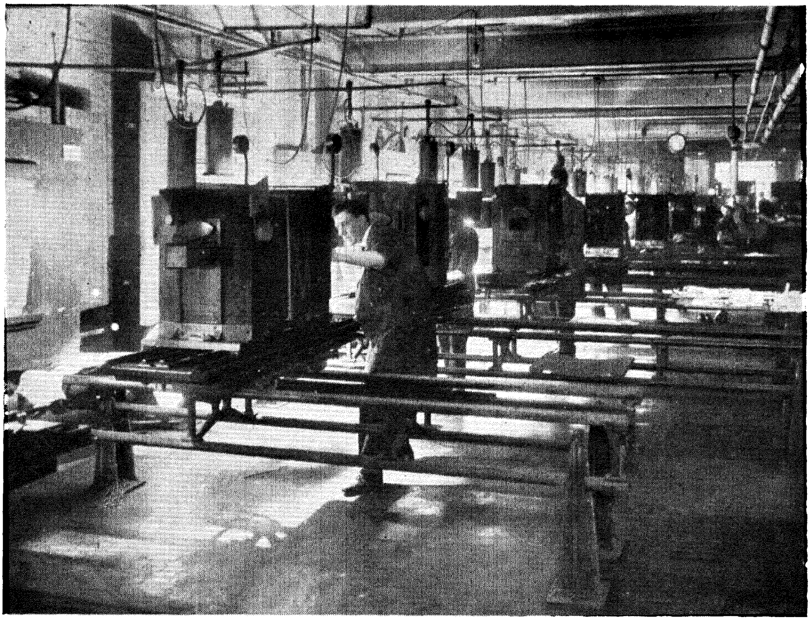
continuous tone, and type portions are assembled and placed on sheets of glass, in a similar manner to the imposition of a type forme, except that a transparent light table is used instead of an imposing stone. The positives are placed in position above a sheet of paper ruled up to the size of the pages, showing margins and positions. When correctly placed they are secured with gummed slips. These glass sheets are then handed to the carbon printer.

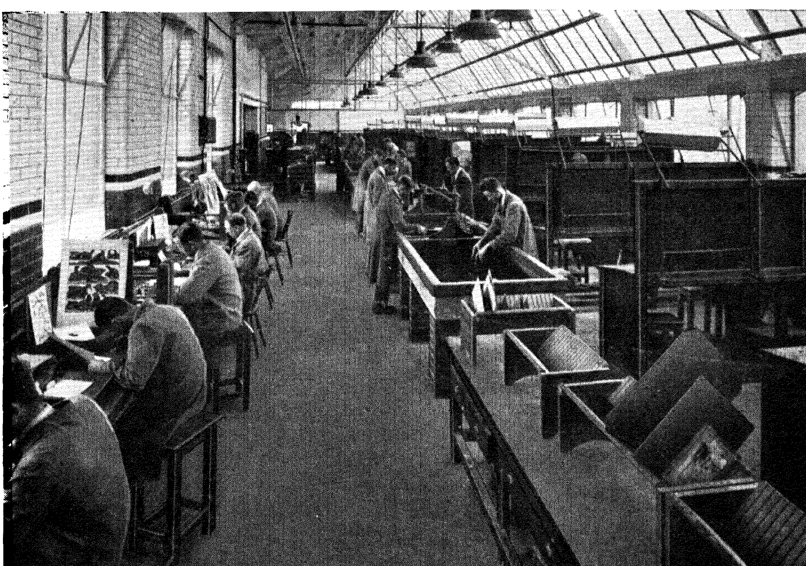
The carbon tissue (see p. 110) is squeezed on to a sheet of glass. (The red pigment of the tissue facilitates control of the etching by its colour and so rendering more visible the green tone of the cupric chloride formed by the action of the etching solution on the copper.) The screen is then printed down by exposure to light on the carbon tissue. The screen normally used has 150 lines to the linear inch (or 22,500 squares to the square inch) and screens up to 400 lines (or 160,000 squares) are used where fine detail is required. The screen in the etched cylinder forms the sidewalls to the ink cells of varying depths which give gradations in tone to the resulting prints. Thus it is the depths of the dots and not their areas which give the tones. The dots in a photogravure print are *uniform* in size (though they often merge into each other) but *vary* in density; in a half-tone print the dots *vary* in size but are of the same density (see Plate XIV).

After the screen is printed on the tissue the positives on the glass sheet are printed on to the screened carbon tissue, and the tissue is now complete and ready for transfer to the copper cylinder.

There are three kinds of cylinders: sheet copper, copper sleeve, and solid copper. The sheet copper is a thin sheet which can be wound around and clamped to a steel cylinder on the printing machine. Such sheets are easily stored, handled, and transported. Sleeves are used on sheet-fed printing machines with a fixed cylinder (or mandril) around which they are placed and which is common to any number of sleeves of the same size. The sleeves may be ground down and re-deposited with copper any number of times. The solid copper cylinder (Plate XIV) is used for large editions on rotary presses, and consists of an iron centre with a copper deposit. A great variety of sizes are used on rotary presses, and cylinders of a standard width of 20, 30, or 40 inches may have a circumference from 25 to 50 inches.

The cylinders are given a deposit of copper of $\frac{1}{16}$ in. to $\frac{1}{8}$ in. electrolytically in copper sulphate baths. They are then turned and ground on lathes, and finally polished on a buffing machine. A variation of ·001 in. in the circumference may mean trouble in printing, as the

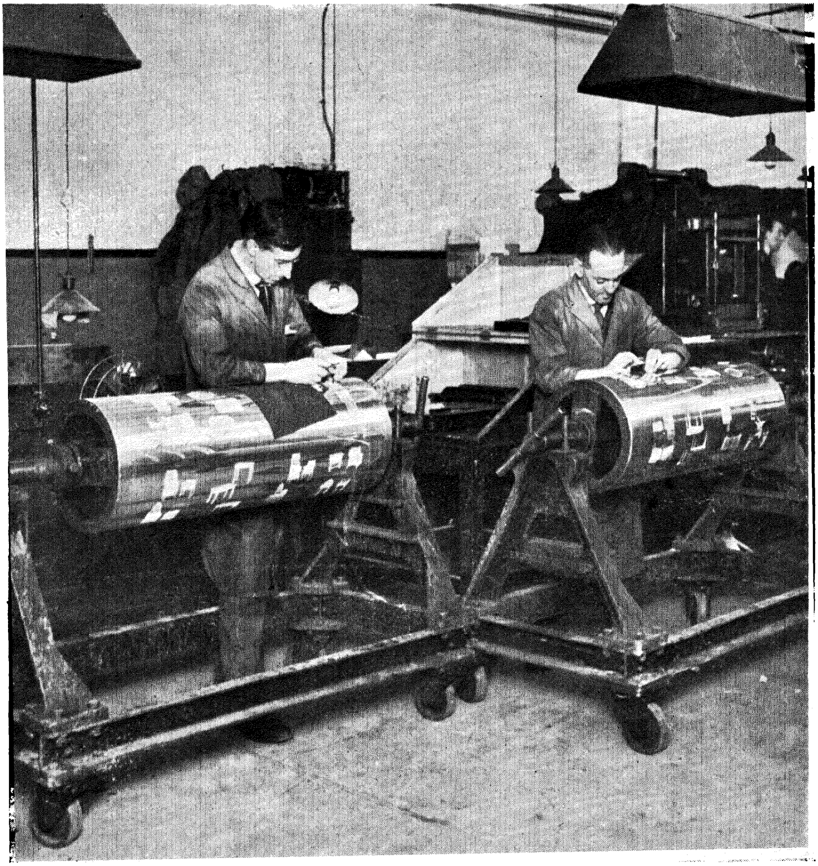




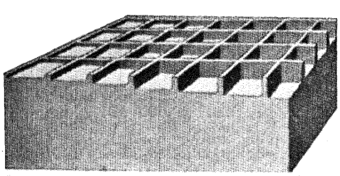
(*Above*) PHOTOGRAPHIC STUDIO AND (*below*) COLOUR-ETCHING DEPARTMENT AT THE SUN ENGRAVING WORKS, WATFORD.

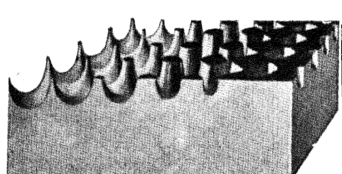
The copy-board is seen at the extreme left of the upper picture. A prism is used in front of the lens to divert rays of light at right-angles.

PLATE XIV



Photogravure cylinders at the Sun Engraving Works, Watford.





Enlarged portion of photogravure plate and half-tone engraving.

[From the *Handbook of Advertising and Printing*, Tudor Publishing Co., Ltd., U.S.A.; British Agents, Hepper & Sons, Ltd.]

speed of the paper-running is governed by the size of the cylinders, and if one cylinder is larger the paper is liable to break.

The copper cylinder on to which the tissue is to be transferred is made clean and free from grease. The carbon tissue is placed in position and held at one edge with adhesive tape. The tissue is positioned to marks on the cylinder which correspond to markings on the tissue, thus ensuring correct position and squareness. The edge of the tissue is put into contact with the cylinder by means of a roller. Water is then passed between the tissue and the cylinder, and the cylinder is slowly revolved so that the dampened tissue passes under the roller, which supplies pressure and causes the tissue to adhere to the cylinder. The paper backing on the tissue is then removed by soaking in hot water, and the different thicknesses of still soluable gelatine on the cylinder cooled and dried. There is now a film of hardened gelatine on the cylinder, composed of the different thicknesses corresponding to the tone values of the positives. The lightest parts of the positive correspond to the thickest parts of the gelatine and vice versa. Unprotected parts of the cylinder are now painted with an acid-resist, and where the type is to be etched separately, these areas are also similarly protected.

The cylinder is now etched with solutions of ferric chloride of five strengths, the process taking about half an hour. A concentrated solution of ferric chloride will not penetrate gelatine and requires the addition of water. This fact allows a certain amount of latitude to the etcher. The etching (as it is dependent upon the absorptive properties of the gelatine resist in exact ratio to the degree of insolubility set up by light in the exposure) depends on the relative strength of the etching solution, the temperature, and the humidity of the atmosphere. After etching, the cylinder is cleaned, and the tissue bearing type matter is transferred, developed, and etched.

In printing the cylinder (Fig. 64) is flooded with ink and superfluous ink scraped away by a flexible steel blade which rides on the cross-lines made by the screen against the rotating cylinder, leaving wells of ink of different depths which are transferred to the paper under pressure. The ink is highly volatile, dries rapidly, and tends to spread slightly, and the lines of the screen are invisible to the naked eye.

Recent photogravure developments include two American processes, the Dultgen and the Henderson.

The Dultgen process is a method of producing a gravure plate or cylinder from the basis of a half-tone engraving. A negative is made from a print of the half-tone plate to give sharp dot-formation on a

contrast plate and another negative on a soft-working plate exposed to give a diffused dot-formation that produces, in effect, a continuous tone negative. The negatives are combined in register to produce a positive which is composed of dots of varying size and in degrees of density corresponding to the original print. Carbon tissue is exposed under the usual screen, the positive printed, the carbon tissue transferred to metal, developed, and etched. The final plate or cylinder shows the half-tone dot formation and the gravure range of tones.

The Henderson process also uses the half-tone screen, a suitable formation of lens stop being used to produce square dots with indented sides separated by clear lines. In etching, the indented sides are lost and the dots become square. No carbon tissue is used; the metal is sensitized with a medium such as bichromated fish glue and etching is quickly effected without a range of baths. The process allows greater constancy in etching as the resist is more stable than carbon tissue and exact duplication of cylinders is possible.

CHAPTER XI

PRINTING PROCESSES TO-DAY

(4) Colour Processes

Without light, colour does not exist. Light consists of waves and the eye is sensitive only to certain light-waves; ordinary photographic plates are sensitive to some visible light-waves and others that are invisible to the eye. The wave-length of the light determines the colour, the wave-length of blues and violets being shorter, for instance, than those of orange and red.

White light is a combination of all the colours; coloured light is white light with some components absent. If white light is passed through a glass prism it is split up into a band of brilliant overlapping colours (called the spectrum) which are its components. The colours, which merge into one another, are red, orange, yellow, green, blue, indigo, violet, and they may be recombined by passing them through a second prism. White light is, then, a mixture of the light of all the wave-lengths; black is the absence of light.

A large number of the colours of the spectrum can be obtained by mixing three colours (called primary) in various proportions (Fig. 51), and colour photography and printing are based on this principle. It is not possible to obtain, in the form of printing ink, primary colours that are permanent and theoretically correct, as two of them do not appear to exist as dyes or pigments. Defects in colour printing due to this cause must therefore be compensated for by varying the theoretical balance by special retouching of the negatives and modifying the etching in the printing plates used for each colour, and even then there is a certain amount of loss in colour value.

All the theories of colour photography are based on the fact that any colour can be matched by using suitable proportions of the light of the three spectral primary colours: orange-red, green, and violet. These colours have a spectral composition of about a third of the visible spectrum of white light.

Colours in the form of light rays differ from pigmentary colours. The primary light or spectral colours are orange, green, and violet; the primary pigmentary colours are crimson-red, yellow, and peacock-blue. Thus, if three projection lanterns were to project beams of orange-red, green, and violet light on to a white screen, the effect

would be white light, and by varying the intensity of the beams, any colour could be obtained. On the other hand, the combination of the three pigmentary colours (crimson, yellow, and peacock-blue) would produce a kind of black (Fig. 51).

In 1857 Clerk Maxwell demonstrated with three negatives (made by the use of filters of coloured liquid in front of the camera lens), and positives made from them, which he projected together in coincidence on a screen, illuminating each positive with the light of the

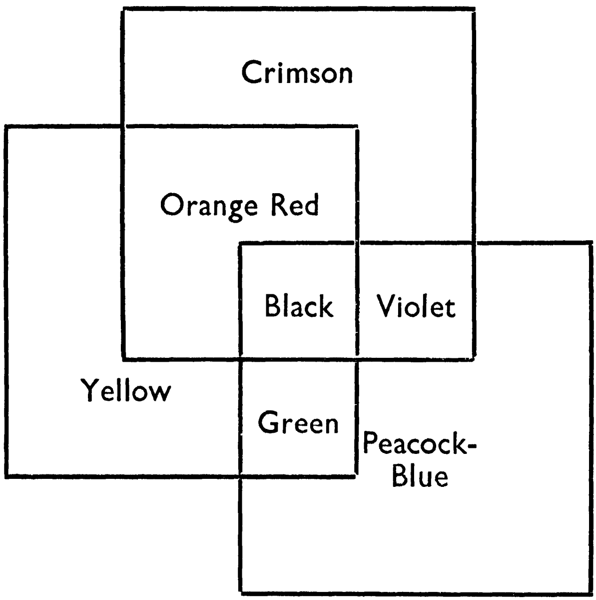


FIG. 51.

Showing how the primary pigmentary colours (crimson, yellow, peacock-blue) combine to produce the secondary colours (orange-red, violet, and green) and black.

same colour as the filter used for making the negatives, that he could produce a coloured picture. This principle is used in colour photography and in colour reproduction by photographic printing processes such as half-tone letterpress, lithography, photogravure, and collotype. The present success of the process, however, depends on the use of panchromatic plates which are sensitive to all colours.

Colour illustration, until the introduction of the half-tone process, was confined to various methods of printing tints, such as are seen in early woodcuts, Baxter prints (which used engraved intaglio plates of stipple and other effects), and early coloured lithographs.

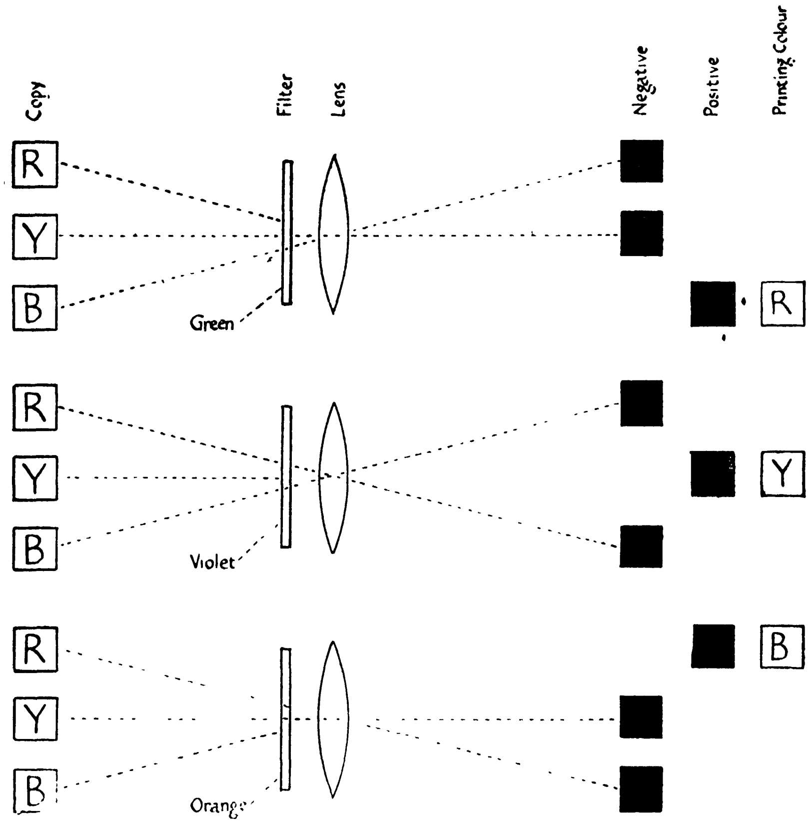
The purpose of light filters in the three-colour process is to separate the colours of the copy into the components of white light by transmitting a certain colour to the negative and by holding back the remainder. Thus, if an orange-red filter is placed between the subject and the negative when it is exposed, the blue is absorbed and only the red and yellow are transmitted.

The order of the colours in the spectrum is *red*, orange, *yellow*, green, *blue*, violet, and these colours are respectively the spectral primaries or filter colours (orange-red, green, violet) and the spectral complementary or printing colours (*crimson*, *yellow*, *peacock-blue*). These printing colours combine to make other colours in the reproduction.

The orange-red filter absorbs all colours except red, orange, and yellow (which are then the only colours that affect the photographic plate); thus the clearer parts of the negative (which become the darker parts of the printing plate made from it) represent the green, blue, and violet. As blue is a mixture of violet and green *light*, peacock-blue is the colour for the printing plate made from the orange-red-filtered negative. Similarly, the green filter absorbs all colours except yellow, green and blue; red, orange, and violet are recorded on the negative. As the mixture of violet and red *lights* is red, the printing plate from this negative is used for printing the crimson. The violet filter absorbs all colours but red, blue, and violet; orange, yellow, and green are recorded on the negative. Yellow being a mixture of green and red *light*, this will provide the printing plate.

The purpose of each filter is to transmit a third of the component colours of white light to the negative and to absorb the remainder; the combination of the two absorbed colours produces the printing colour (Fig. 52).

Three primary printing colours printed on top of one another would give the effect of a muddy black. The angle of the half-tone screen is changed for each colour so that the dots do not print over one another but form a kind of rosette pattern (Fig. 53) and at the same time avoid forming a moiré pattern. The principle is similar to the *pointilliste* school of French painting. The screen for normal one-colour half-tone is 45°. In three-colour half-tone printing the angles are separated by 30° from each other: yellow 105°, red 75°, and blue 45°. A black plate is usually added to strengthen detail and to obtain certain neutral shades of grey and purer tones of red and blue. In this case the angles used are: red 105°, yellow 90°, blue 75°, black 45°. A new method of half-tone screen shifting



Spectrum	Red	Orange	Yellow	Green	Blue	Violet	Printing Plate
Orange-red filter:	passes	passes	passes	absorbed	absorbed	absorbed	peacock-blue
Green filter:	absorbed	absorbed	passes	passes	passes	absorbed	crimson
Violet filter:	passes	absorbed	absorbed	absorbed	passes	passes	yellow

FIG. 52.

Showing the effect of the filters. The primary spectral colours are orange-red, green, and violet. The primary pigmentary (printing ink) colours are crimson, yellow, and peacock-blue; the printing plate for each primary pigmentary colour is obtained by using the filter of the other two, i.e. the orange-red filter (a combination of red and yellow) gives the blue printing plate, the green filter (yellow and blue) gives the red printing plate, the violet filter (red and blue) gives the yellow printing plate.

control is now used, whereby the dots are juxtaposed with the centres equally distributed over the printed area, thus avoiding circles of dots with white centres and overlapping dots (which tend to produce blacks and to lower the purity of the colour), and the rosette pattern produced by screen rotation.

This method of making three negatives by three separate exposures through three different filters is known as colour separation. An apochromatic lens (one in which the foci of the three primary colours fall in the same plane) and panchromatic plates are required as already

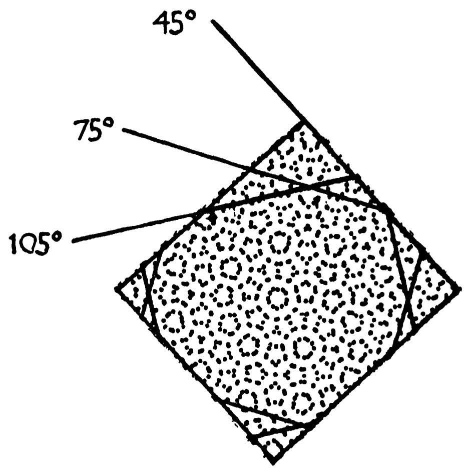


FIG. 53.
Showing the rosette pattern formed by the screens of three-colour half-tone printing

stated. The various angles of the screen are obtained by rotating the screen holder.

Two methods are used: indirect and direct. The indirect method is used when the copy cannot be brought to the studio, such as flower gardens or gallery pictures. In this case continuous tone negatives are made through colour filters and from these negatives a set of positives is made; from the positives screen negatives are made. Thus two negatives and one positive are required for each of the colours.

In the direct method, each exposure is made through the filter and the screen at the same time, the amount of exposure being varied according to the circumstances and the density required for each negative.

Colour photography at speed is now possible by simultaneous exposure instead of separate exposures, thus enabling the reproduction

of moving objects in colour. In the camera the filters also act as transparent mirrors. The yellow rays pass through the first filter, while the red and blue rays are deflected across to the next filter. The red rays pass through the second filter, leaving the blue to be deflected to the third surface (Fig. 54), thus the three primary colours are recorded instantaneously on three separate plates.

The principle of fluorescing originals already mentioned is also applied to colour work. It aims at improving photo-mechanical colour reproduction by producing separation negatives from coloured

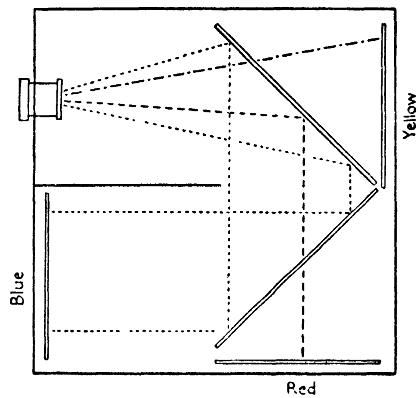


FIG. 54.

Diagram of one-shot camera for instantaneous and simultaneous exposure for colour-separation negatives. Dotted lines show the path of the light rays as they pass through the colour-filter prisms or are deflected.

copies prepared with fluorescent pigments and illuminated with special lighting. The colours are in balanced sets of fluorescent water-colour paints which require no special medium but only water. The fluorescence in the colours is proportioned so that each colour bears the correct photographic relationship to the others.

Methods of colour photography—such as Dufay colour (*frontispiece*), Finlay, Vivex, Kodachrome, and others—are used for colour reproduction in printing. Colour positives or transparencies are now made by the use of special film, the three separate primary colour images being embodied in the film at one exposure. The surface of the emulsion (in Dufay colour, for instance) has a mosaic of colour filters of microscopic size intermingled in close juxtaposition, a geometrical mosaic of blue and green squares separated by red lines; there are about a million colour elements to the square inch. The Finlay film uses a

chess-board mosaic and emulsion on two separate plates which are exposed in contact. The resultant negative may be used for making three-colour positives (by means of stop-out screens) from which negatives may be made, it is claimed, without the need for any colour correction.

In the Vivex process the separation negatives are measured for density and treated, if necessary, by a system of controlled intensification. From each negative a bromide print is made so that the densities and contrasts are identical. The prints are then brought into contact with sheets of pigmented gelatine which contain primary coloured pigments. Each print is duplicated in hardened gelatine by exposure. The bromides and the coloured tissues are stripped apart, and the bromide is then found to be bleached out and a faint visible image produced on the pigmented gelatine, the result of hardening process. The gelatine surface is then covered with a support to carry the image in subsequent operations, in which the unwanted pigment is removed and the colour-images assembled in coincidence. Identical prints in colour present no difficulty. These prints are then used as originals for the three-colour process, and form a constant reference throughout the making of the separation negatives, etched plates, and printing on the machine. In half-tone engraving colour correction can be calculated from the Vivex prints, and both the prints and the proofs of the colour plates can be used to control the colour throughout, although different makes of trichromatic inks may call for modified fine etching on the plates.

Dufay colour (*frontispiece*) uses a means of controlling the contrast of a transparency without altering the saturation of the colour, thus allowing the use of contrasting materials for preparing separation negatives and giving correct final gradation to them.

Kodachrome sub-film (1 in. × 1½ in.) transparencies have been used commercially for making enlarged colour separation negatives for lithographic posters up to 40 in. × 60 in. Kodachrome is now available as cut-sheet film in the usual sizes which eases the engraver's work. The necessary colour correction is governed by the printing inks used and is controlled so as to reduce the amount of ink of one colour in proportion to the amount of one or both of the others which are printed with it.

Each set of trichromatic inks needs its appropriate colour-correction. Masking is a term used to describe the preparation of colour-corrected separation negatives by combining positive transparencies made to suitable contrast from one or both of other separation negatives with certain of the ordinary separation negatives. Separation negatives

need the correction of colour values because pigments of the correct absorption factor in relation to the colour filters are not available. In half-tone letterpress, fine local etching may be done on the printing plates to compensate for imperfections in the negative and the printing inks. Such work requires great skill and experience (Plate XIII).

In photo-litho offset, modifications of the values must be made before the plate is printed down. Although, with a suitable original, good results are possible with three colours, most of this work uses four to six printings, each plate being made on the three-colour principle and supplemented by hand-correction, the negatives for the additional colours being prepared from careful manipulation of the original negatives. The extra printings are usually one or more of black, grey, light blue, pink, or sometimes a special colour which is better obtained from an extra printing than by a combination of two or more of any other colours.

A tremendous amount of skilled hand-work is often required for the successful production of a set of colour plates. Such work needs considerable judgment on the part of the retoucher as there is no means of assessing the final result until the printing plates are made and proved in colour. If the proof is unsatisfactory additional work has to be done on the negatives and new printing plates made.

Colour photogravure gives an unequalled range of tone value. The screen does not modify the values as the ink is deposited according to the depth of tone and is built up proportionately. Light tones are therefore correctly rendered instead of being translated into dots (which are *solid*, however small) as in litho, offset, and letterpress. Quick drying between the printing of each colour keeps the colours pure, and the vehicle used for the pigment does not tend to degrade the colours or the tones. The methods of colour separation are similar in principle to those used for other printing processes.

Ansco is an American direct reversible colour film, similar to Kodachrome, but it can be processed in a short time and does not need to be returned to the manufacturers as Kodachrome does.

CHAPTER XII

MACHINES AND MACHINING

PRINTING machines may be classified into three kinds: (*a*) platen machines; (*b*) cylinder machines; and (*c*) rotary machines, according to the principle by which impression is obtained. In platen machines both the paper and the printing surface are in one plane (horizontal in the hand-press, vertical in the platen machine). In a cylinder machine the paper is wound on a cylinder and pressed on to a horizontal flat printing surface by the revolution of the cylinder. On a rotary machine the printing surface (a stereotype cast, lithographic or intaglio plate) is placed around the periphery of a cylinder and revolves with it in contact with the paper (carried around another cylinder), which is in a continuous roll or web (Fig. 61).

Printing consists of four main operations: feeding or positioning the paper, inking the printing surface, impressing the ink on to the paper, and delivering or removing the printed sheet so that another may be positioned.

Early printing, as we have seen, was done on hand-presses, which are still in use in some commercial offices for the purpose of taking proofs, and in private concerns which use them to control by hand the printing operation, to obtain richer inking, and other real or imaginary aesthetic advantages.

Printing on a hand-press involved inking the forme with the balls, laying a sheet of paper on the tympan to guides and points, folding over the frisket, lowering the tympan (with the frisket) on to the forme, running the forme under the platen, pulling the handle to take the impression, running the bed back, lifting the tympan and frisket away, and taking off the sheet.

The platen machine (Fig. 55) makes its impression with a vertical contact between the platen and the forme in a vertical position. The forme is clamped against the bed of the machine, the paper is laid to guides on a flat bed (the platen), the platen is raised, carries the paper to the inked forme, and lowers itself for the printed paper to be taken away and another sheet to be positioned. The inking rollers are in a frame which travels from the inking slab (which is a disc in two or more parts revolving in different directions) above the bed to the base of the bed, the ends of the rollers revolving over flat bearings at the sides of the bed. The ink trough or duct at the head

of the machine carries a supply of ink to the slab by means of a distributing roller. In front of the machine is a small table for receiving the printed sheets, and at the side another table which holds the paper to be printed. The 'minder' of the machine places the sheets in ('lays on') with the right hand and takes them out with the left hand when the platen retires from the forme. There is a checking device

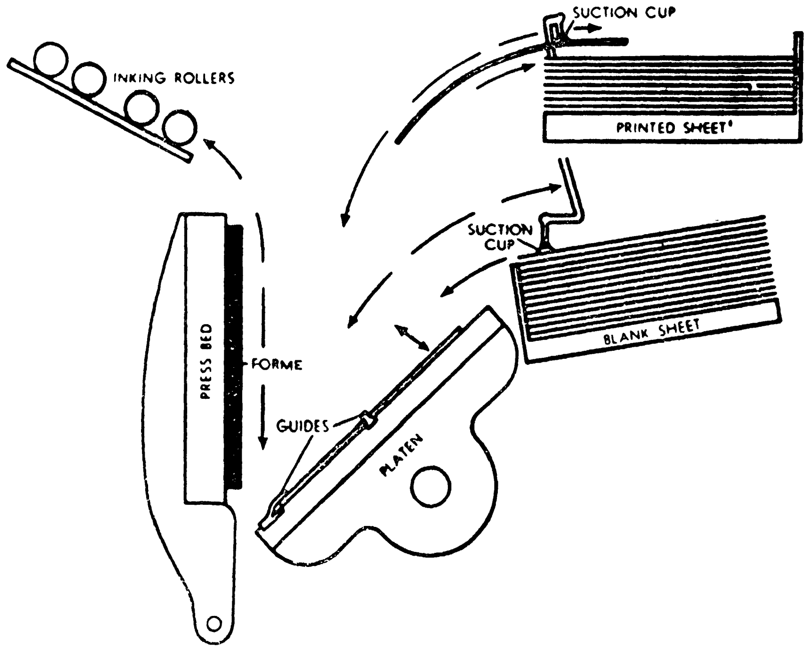


FIG. 55.

Principle of the Platen Machine. The forme is held in a vertical position by means of a clamp. The platen rocks to a parallel position with the bed as the bed moves towards the platen. The paper sheet is fed against the guides on the platen and the printed sheet is removed just before a fresh sheet is laid in position. The press shown here has an automatic feed and delivery.

[From the *Production Year Book*, Colton Press Inc., New York.]

for preventing contact between platen and forme when a sheet is incorrectly fed or missed. The paper is held during printing by flat pieces of steel acting as fingers, which are laterally adjustable. There are, of course, many types of machine, some with enclosed motor drive, automatic feeding and delivery. The Cropper and the Victoria probably are the two most widely known. Platen machines are mainly used for small work up to 15 in. × 10 in.

In a cylinder press the impression is made by a revolving cylinder

that carries the paper and impresses it against the printing surface, which is secured on a flat horizontal or vertical bed. The vertical bed is used on small automatic machines, and the usual cylinder machine is of the horizontal bed type. On a platen machine the whole of the printing surface comes into contact with the paper at the same time; on a cylinder machine only about half an inch of the

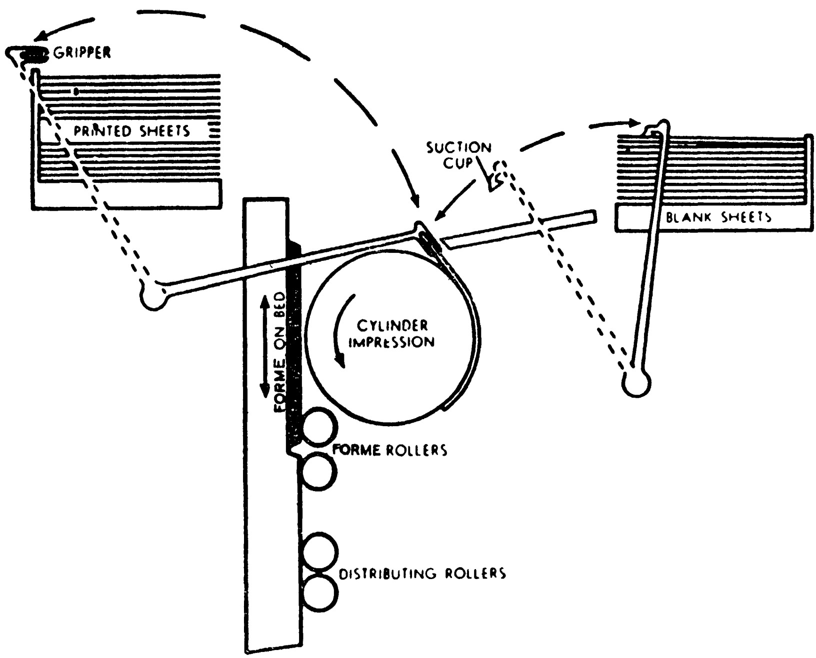


FIG. 56.

The principle of the Vertical Miehle. A cylinder press (see Fig. 57) in which the forme is locked vertically on the press instead of horizontally. (Plate XVIII shows the back view of the machine with the inking arrangements.)

[From the *Production Year Book.*]

circumference of the entire width of the cylinder is in contact with the forme at any moment.

The cylinder movement varies according to the type of machine. In the stop-cylinder machine (Plate XV) the cylinder turns in contact with the bed (with the forme on it) to print the sheet, then stops to allow the bed to return. The cylinder is geared to the moving bed, but has a portion of the teeth on the fixed cylinder wheel cut away (or a loose wheel working on the cylinder shaft) so that as the bed returns the cylinder remains stationary. In the two-revolution press the cylinder makes one revolution to print the

sheet and another revolution to deliver it. The cylinder is lifted free of the type bed during the second revolution.

The bed carries the forme and the ink table, has a reciprocating travel, and runs on anti-friction rollers. The cylinder is a metal drum with a slit cut through the whole length, and turns anti-clockwise. The feed board on stop-cylinder machines is at the base of the

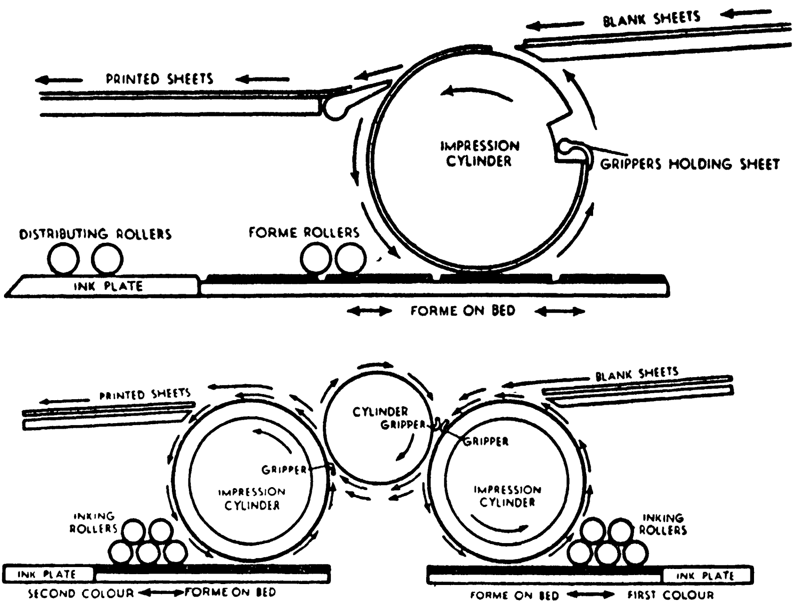


FIG. 57:

The principle of the Cylinder Machine. The forme is locked on the horizontal bed of the press. The bed travels to and fro, the paper is held on the cylinder by grippers and impressed when the cylinder is in contact with the forme. The two-colour cylinder press transfers the paper after the first impression to the second cylinder and the same side of the paper receives the second impression.

[From the *Production Year Book.*]

cylinder. On the front of the board are gauges to which the sheets are laid. Behind the board, on the cylinder, are grippers which are movable along a gripper bar. The grippers close to take the sheet, which they hold while it is being printed. They then open to release it, when it may be taken off by hand or delivered to a receiving board in various ways. Flyers are an apparatus for receiving the sheet by grippers from the grippers of the cylinder, carrying the sheet around a drum and delivering it to a taking-off board. The inking arrangement consists of a duct, a duct cylinder, a feeder, and distributing and inking rollers. The duct is a metal trough of which one side is

formed by a cast-iron roller, the ink duct cylinder, which revolves, and the other side by a triangular piece of iron, the duct knife. The closeness of the ink duct cylinder to the duct regulates the flow of ink and is regulated by screws at the back of the duct. The duct cylinder has a pawl and ratchet worked by a rod and ink delivery is automatic. Next to this cylinder is a composition roller (the feeder) which moves up and down to transfer ink from the duct to the ink table. Distributor rollers are placed at an angle across the machine and distribute the ink; they are not geared but are actuated by the movement of the ink table. Near the impression cylinder is another group of rollers, also actuated by the movement of the bed, which pick up the ink from the ink table and effect the actual inking of the forme. Later machines use a pyramidal arrangement of inking rollers and riders in complete contact, and there are various types of delivery including chain grippers, overhead conveyance, and so on.

The two-revolution cylinder flat-bed machine (Plate XVI) was designed for increased speed and efficiency. The bed is actuated by racks and a pinion, and the cylinder is driven independently of the bed and revolves continuously, both movements being synchronized. The first revolution of the cylinder takes place when the bed is travelling from the ink duct or delivery end to the feed-board end; the second revolution takes place when the bed is travelling in the reverse direction. After the impression has been made on the first revolution, the cylinder lifts to clear the forme so that the overlay and packing is not impressed or printed by the forme, which would cause the impression to be 'set off' on the back of the next sheet that was printed. The cylinder may be tripped or checked by a foot lever.

The feed-board is positioned over the cylinder, which revolves in the opposite direction to the stop-cylinder machine; consequently the sheets are fed face upwards instead of face downwards as in the stop-cylinder machine. The cylinder is positively driven from the driving shaft, and the reversion of the bed is controlled by a rack-wheel, running in a continuous direction, between an upper and lower rack. The rack-wheel engages alternately with the upper rack for the forward movement and the lower rack for the return movement.

The inking is done by an arrangement of forme inkers and distributors which are gear-driven (Plate XVI).

After the sheet has been printed it is taken off the cylinder by

stripper-fingers, and assisted by tapes and a frame of sticks to the delivery table where a jogging apparatus ensures an even pile.

Two-colour letterpress cylinder machines have two impression cylinders, two ink slabs, and two sets of inking arrangements. Between the two cylinders is a transfer cylinder, which transfers the sheet after its first printing to the second cylinder. In printing, the

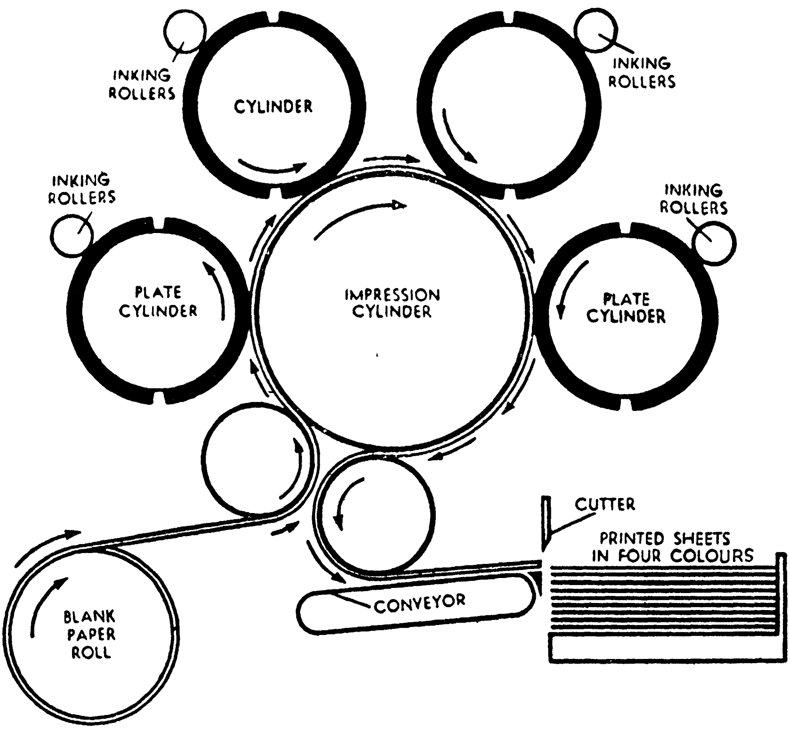
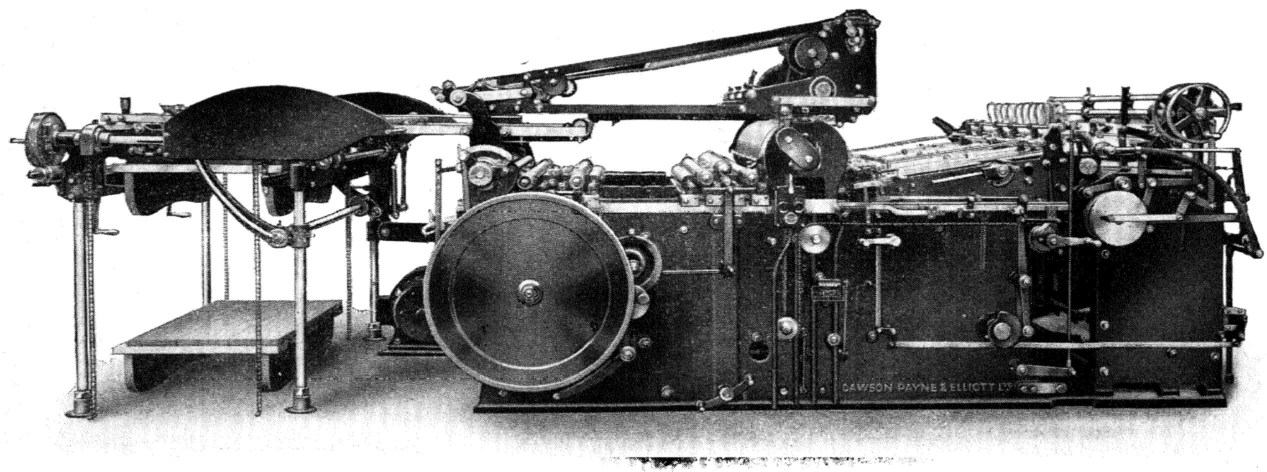


FIG. 58.
The principle of multi-colour letterpress rotary machines, used for fast printing in several colours. The paper can be fed in sheets or from the reel.
[From the *Production Year Book*.]

first forme is positioned on the bed to obtain the correct position on the paper, and the second arranged to coincide with this position. One cylinder can be run independently of the other for single-colour work.

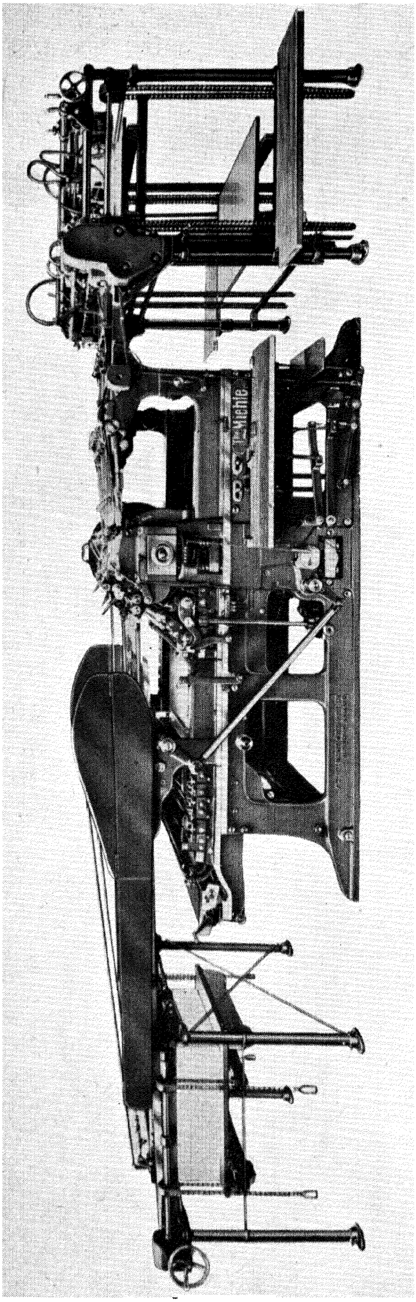
'Perfecting' is a term used to describe the printing of a sheet on both sides, and a Perfector is a cylinder machine which prints both sides of the paper as it passes through the machine. Both sides are not printed simultaneously. There are two impression cylinders, two beds, two ink-slabs, and two sets of inking apparatus.

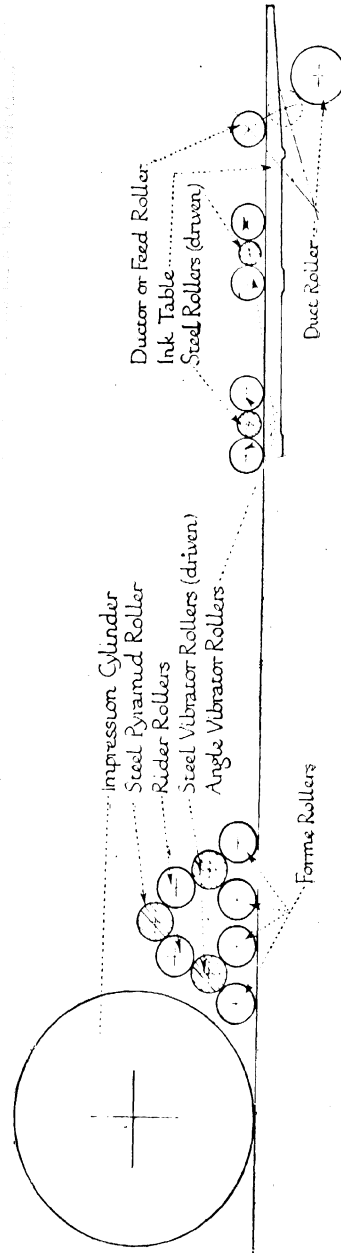
PLATE XV



A Standard Wharfedale (Stop-Cylinder) machine with automatic feeder and pile delivery.

PLATE XVI




Impression Cylinder
Steel Pyramid Roller
Rider Rollers
Steel Vibrator Rollers (driven)
Angle Vibrator Rollers
Forme Rollers
Ductor or Feed Roller
Ink Table
Steel Rollers (driven)
Duct Roller

The machine is fed from the feed-board, and the two cylinders revolve inwards towards each other. The grippers of the first cylinder take the paper, which receives its first impression. As the sheet leaves the control of the grippers of the first cylinder it is taken by the grippers of the second cylinder, passes under it, and receives an impression on the reverse side. The sheet is then received by a smaller take-off cylinder, passed on to tapes, where it is caught up by a frame of sticks and deposited on the delivery table.

Set-off means the undesirable transfer of wet ink from one side of the sheet to the other by contact or pressure, and perfecting machines have an anti-set-off device which consists of four rollers. These rollers receive a preparation of paraffin wax, benzine and oil, and distribute it over the manilla packing on the second cylinder, which, thus treated, does not take up ink, and the first impression is therefore not affected by the second. In order to obviate any risk of set-off, the forme containing most printed matter is usually printed on the second cylinder.

The difference between a cylinder machine and a rotary press is that in rotary machines the printing surface is curved. On letterpress rotary machines, therefore, the type and blocks must be cast in the form of curved stereotypes for affixing to the printing cylinder. This principle enables reels, rolls, or webs of paper to be used, although there are sheet-fed rotary machines. Rotary printing from reels can be done at enormous speed, and it is this method that makes possible large-circulation newspaper and periodical production.

The increased speed is due to the fact that all operations are continuous; the forme or printing cylinder and the impression or blanket cylinder always turn in the same direction, and the paper from the reel is unwound as required. Inking is simple, as the rollers are placed against the printing cylinder; perfecting is simple by the use of a double printing unit; and folding, cutting, and counting are

---

PLATE XVI.

The Miehle is a typical two-revolution letterpress machine. It is here shown as a completely automatic unit. In the centre is the machine proper. At the right-hand end of the press is the automatic sheet feeding mechanism, which separates each sheet from its pile and feeds it to the press. This is effected by means of blowers and vacuum suckers. The sheet pile is automatically raised so as to maintain a constant level at the top. Meanwhile, on the board below the pile, another stack of paper can be piled ready for feeding. On the left of the press is an apparatus known as the pile sheet delivery, where the printed sheets are deposited printed side up. This pile gradually descends as the sheets are delivered. When the pile is completed, it is rolled away on a trolley. The inking arrangements are shown in the diagram. [*Linotype & Machinery Limited.*]

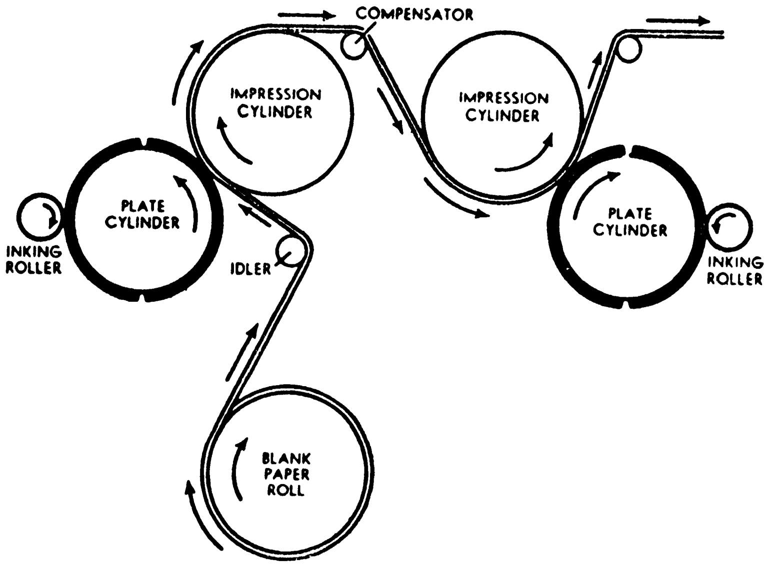


FIG. 59.

The principle of rotary perfecting machines. The paper is printed (from sheets or reels) on both sides in one operation. This type of machine is mainly used for magazine and newspaper printing.

[From the *Production Year Book.*]

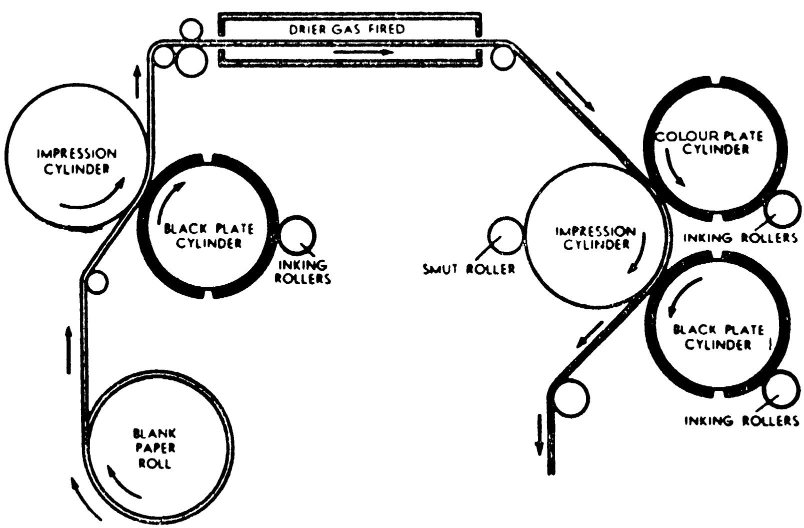


FIG. 60.

The principle of rotary perfecting machines for colour work. Additional cylinders for other colours are added at either side and many combinations of colours and black are possible.

[From the *Production Year Book.*]

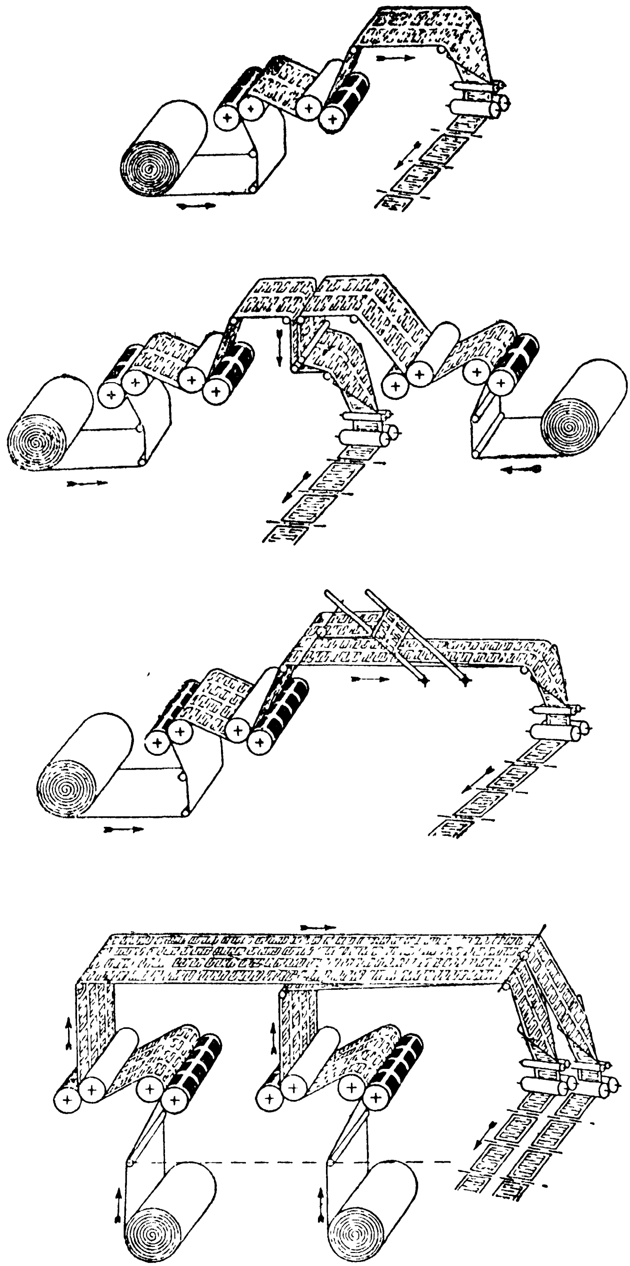


FIG. 61.

Types of letterpress rotary machines: one reel of single width, one folder; two reels of single width, one folder; one reel of double width, one folder; two reels of double width, two folders.

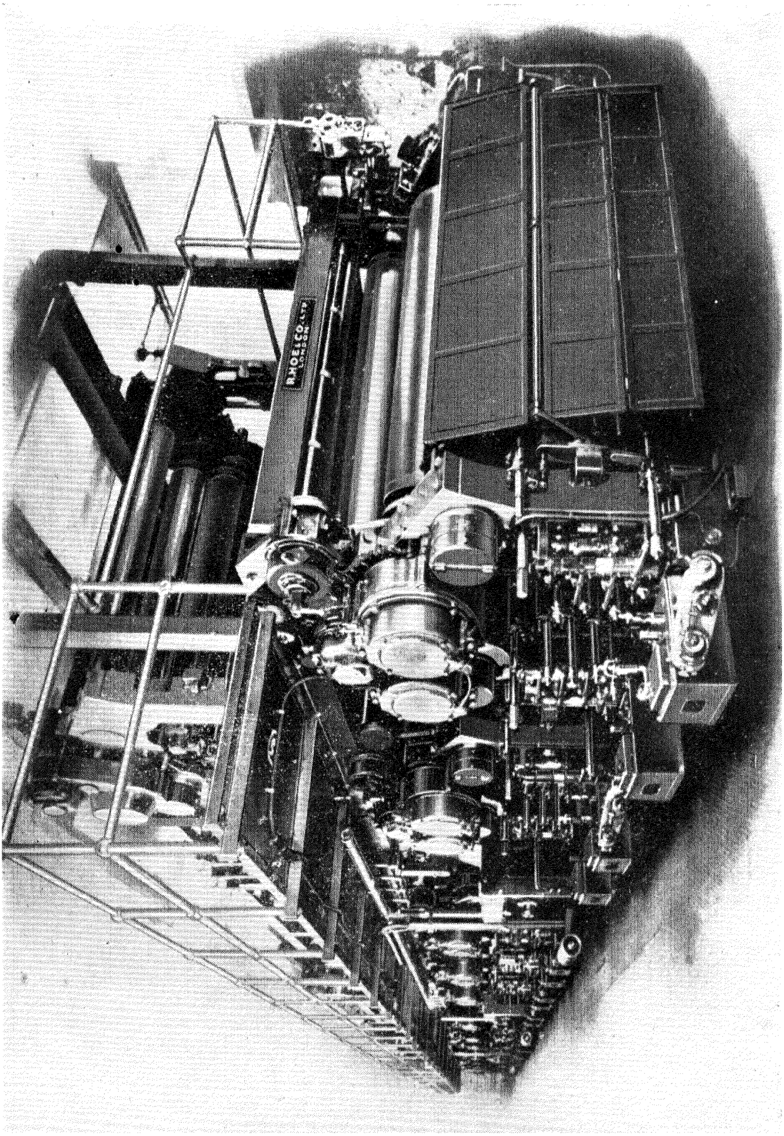
automatic. The output of combination or multiple web machines is practically unlimited.

In the development of the rotary press the aim was to produce machines that would give a varying number of pages, and this was effected by making presses 2, 3 or 4 pages wide and combining a number of units, each printing from its own web or conveying the printed web to the same folder for cutting and gathering into complete copies.

Rotary presses for newspaper printing are run one after the other in line (which seems to be the general tendency to-day), or in decks, one above the other, from two to five, and may be single-width (carrying four plates on each printing cylinder of each unit, giving two 4-page papers), or double-width (carrying eight plates on each cylinder and giving two 8-page papers). By multiplying the units and increasing the cylinder width greater outputs can be obtained. The cylinder speed is about 18,000 revolutions per hour, and higher speeds are handicapped by the tensile strength of the paper used. Increased output is therefore in the direction of multiplication of printing units.

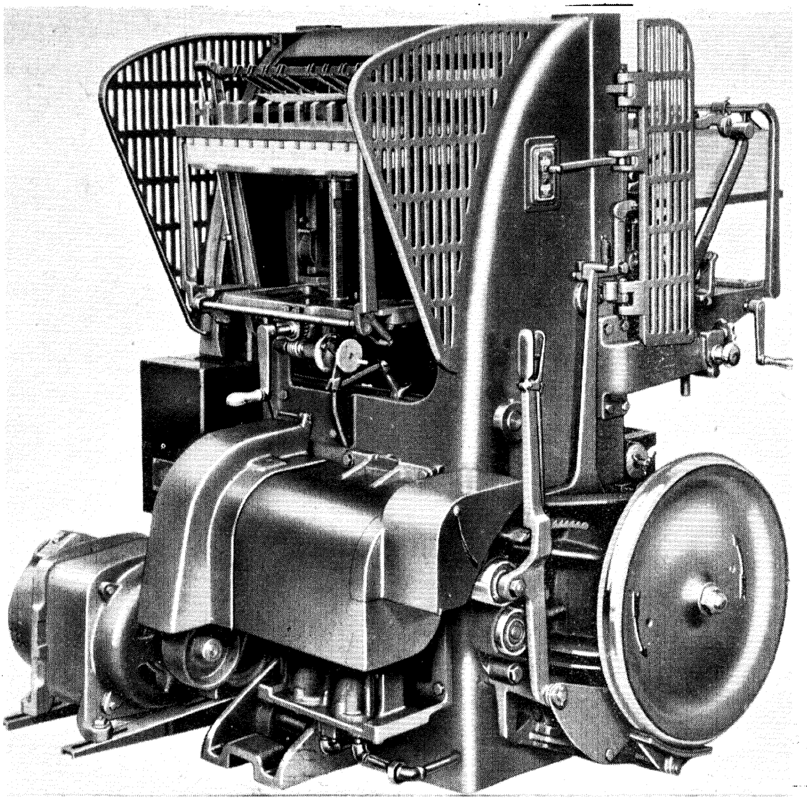
The Hoe machines in *The Times* office impress reels of paper at the rate of 20,000 revolutions an hour. Each unit prints two sections of eight pages each at every revolution of the cylinder, and each of the nine folders produces 40,000 copies of *The Times* an hour, totalling 360,000 copies. When the reel stands are loaded they accommodate ninety reels, and twenty-four printed sheets can be cut, folded, and delivered at a rate of eleven a second. The rolls of paper (which may be about five miles long and weigh three-quarters of a ton) are carried on magazine reel stands carrying three reels, one in use, one ready in running position, and one standing by. A fresh reel is joined without stopping the press. The web is led between rollers over the paper reels, one roller being fixed, the other mounted on a hinged bracket. The leading edge of the new web is pasted and taken over one of the rollers and, when ready for the join, the press is slowed down and the hinged roller swung over to the fixed roller carrying the pasted web and the join is made. The two webs run into the press for a short distance, and then the old web is broken off and the press resumes its normal speed. If the web breaks, an automatic brake cut-out comes into operation and stops the press so that the web does not wrap itself around the cylinders and rollers. Breaks in the web sometimes happen if the press is stopped suddenly, and to overcome this, special magnetic brakes are used by which brake pressure is gradually increased.

PLATE XVII



Hoe Rotary Super-speed, Six-unit, Line-type Press.

PLATE XVIII



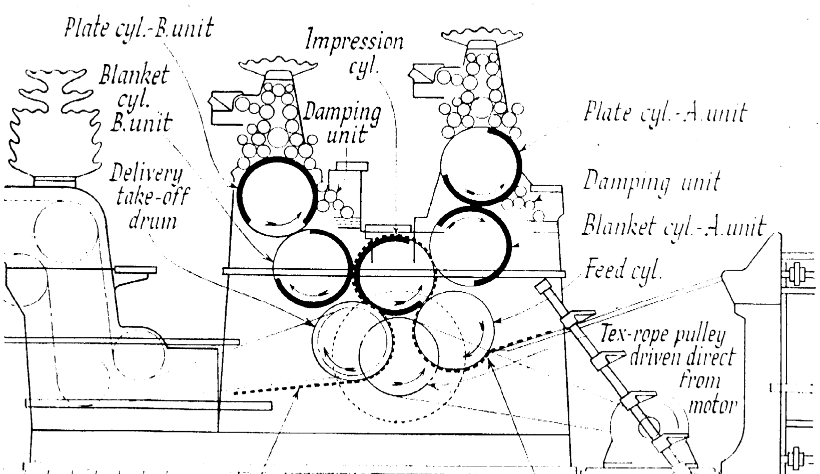


Plate cyl.-B.unit
Impression cyl.
Blanket cyl. B.unit
Damping unit
Plate cyl.-A.unit
Delivery take-off drum
Damping unit
Blanket cyl.-A.unit
Feed cyl.
Tex-rope pulley driven direct from motor
Path of sheet shewn by thick dotted line

For the insertion of late news a fudge box is used which is made of tapered metal division slips between which Linotype slugs may be held. The sides of the box are movable and have saw-toothed edges to grip the slugs securely when a wing nut is tightened. Some types of box have a printing device for independent inking, and there are also non-stop late news printing cylinders equipped with fudge boxes.

Automatic ink-pumping was introduced about 1916. The ink comes in a tank-lorry and supplies a central tank which feeds the presses by compressed air, the ink being strained on the way. A pump box outside the press frames of the machine is fitted with adjusting screws to regulate the flow to each unit; ink is regulated according to the number of pages being printed. The printing plates are inked by rubber-covered forme rollers of different diameters, which are connected with oscillating gear-driven steel rider rollers. Rubber rollers last longer and require no washing.

The tubular-plate rotary prints from tubular stereotype plates instead of semi-cylindrical ones. Each plate is a complete page and encircles the cylinder except for a narrow margin space. The plates are thinner and less than half the diameter, and the press cylinders are half the diameter of the usual rotary press. Double the output can be obtained with half the number of plates.

Rotary presses consist of five main units: reel-holders and justifying gear, printing and inking units, cutting devices, delivery system (either by tapes, pile, or travelling band), registering mechanisms (to adjust work printed in more than one colour), and such auxiliary attachments as paper turnovers (for perfecting), folding gear, and re-winding devices (for further printing on other units, or after the reel has been slit into narrower reels).

PLATE XVIII.

(*Above*) The Vertical Miehle differs from the platen machine; the motion of the bed of the press is vertical, i.e. the bed moves up and down, the bed and the cylinder being counterbalanced. It therefore embraces the principles of both the platen and the cylinder press. The method of inserting and clamping the forme to the bed is similar to that on platen machines; the method of feeding and delivering the sheet is similar to that on cylinder machines. The Vertical Miehle is automatic and incorporates a swing-away automatic feeder. The delivery table is lowered automatically as the sheets are delivered. The machine prints sizes from postcard to 13½ in. × 20 in., occupies 4 ft. × 5 ft. floorspace only, and has a maximum speed of 4,500 per hour.

[*Block by courtesy of The Miehle Printing Press & Manufactering Co. Ltd.*]

(*Below*) Basic design of the Mann 'Fast Five' Two-Colour Rotary Offset Machine. The sheets are fed automatically and delivered printed side up at speeds up to 6,000 per hour (according to the nature of the work). The printing pressure can be micrometrically adjusted and the register (coincidence) of the printing plates is set with a precision vernier gauge (see p. 137).

Lithographic Presses

In general, presses for printing processes other than letterpress vary only in detail from those already described. The lithographic hand-press takes a stone or plate on the bed, the stone is inked with a hand-roller, the paper laid on the stone, some sheets of paper are laid on top, and the whole is covered with a hinged tympan of leather or metal. The bed is moved forward to bring the tympan-covered stone under a pressure bar or scraper of wood, which gives a scraping pressure as the bed travels under it. The pressure is released, the bed returned, the tympan raised, and the proof carefully peeled off.

The principal difference between a direct lithographic flat-bed machine and a letterpress flat-bed machine is the addition of damping rollers. Such machines are used for stone lithography. There are arrangements for raising or lowering the stone or plate on the bed of the press according to its thickness, and in addition to the inking slab, there is a slab at the other end of the machine for damping. A roller revolves in a trough of water, which is conveyed from this roller to the slab by other rollers. The moisture is imparted to other damping rollers which act similarly to inking rollers.

The lithographic rotary machine uses plates only. There are two cylinders, a plate cylinder and an impression cylinder. The periphery of the plate cylinder is more than twice that of the sheet it prints, as a third of it is used as an ink slab. Separated from the ink slab by two gaps is the printing plate, which is secured by clamps and affixed around the cylinder. The cylinders revolve in opposite directions and are of the same periphery. The inking arrangement is more elaborate than on a flat-bed machine, and every roller revolves whether in contact with the slab or the impression cylinder, as they must revolve at the same speed. The machine can be tripped so that the cylinders are separated and the inking rollers lifted, and no ink from the plate is transferred to the impression cylinder when sheets are not being fed. The advantage of the rotary machine lies mainly in its increased speed, also in the solidity of impression and the amount of ink that can be imparted to the paper. A good deal of time is saved in changing plates as compared with a stone; a 60 in. ×40 in. stone needs block and tackle and labourers. The largest plate weighs only a few pounds; a large stone may weigh half a ton.

The offset flat-bed machine is similar to the direct lithographic flat-bed machine, but has an additional cylinder carrying the rubber blanket. This type of machine is widely used for tin-printing in

addition to printing on paper. Attachments are available for converting flat-bed lithographic machines into flat-bed offset machines, and the offset machine may be converted into a direct flat-bed in a few minutes by throwing the offset attachment out of action. The impression cylinder of an offset machine, unlike that of a direct lithographic machine, has no covering; pressure is effected by means of adjustable spiral springs which press the cylinder against the

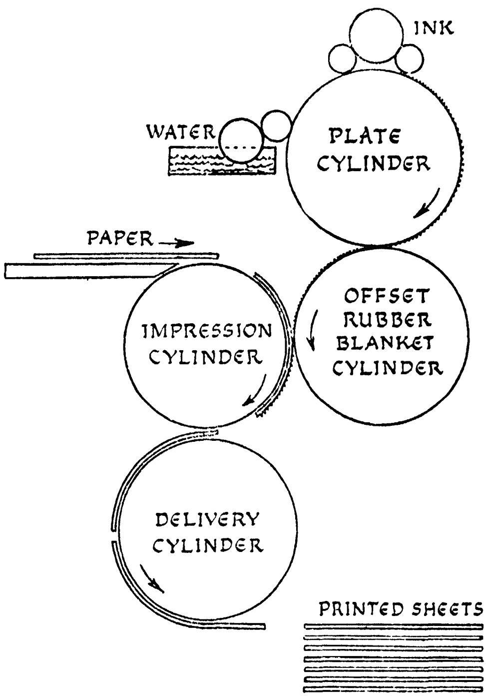


FIG. 62.
Principle of offset machines.

blanket cylinder. The paper is fed to the blanket cylinder and is taken between this cylinder and the impression cylinder to which it is transferred. These machines may be used with stones or plates or for direct lithographic or offset work.

Single-colour rotary offset machines have three cylinders: the printing plate cylinder, the blanket cylinder, and the impression cylinder. Some plate cylinders formerly carried an ink slab, but this has been eliminated so that the size of the cylinders may be reduced and speed increased. The impression cylinder is usually

without covering and may be the same size as the other cylinders; in two-revolution presses, it is half the size, and revolves twice to every revolution of the blanket cylinder. The first revolution gives the impression and at the second revolution the sheet is released for delivery.

Inking rollers are of leather or of a synthetic composition which is

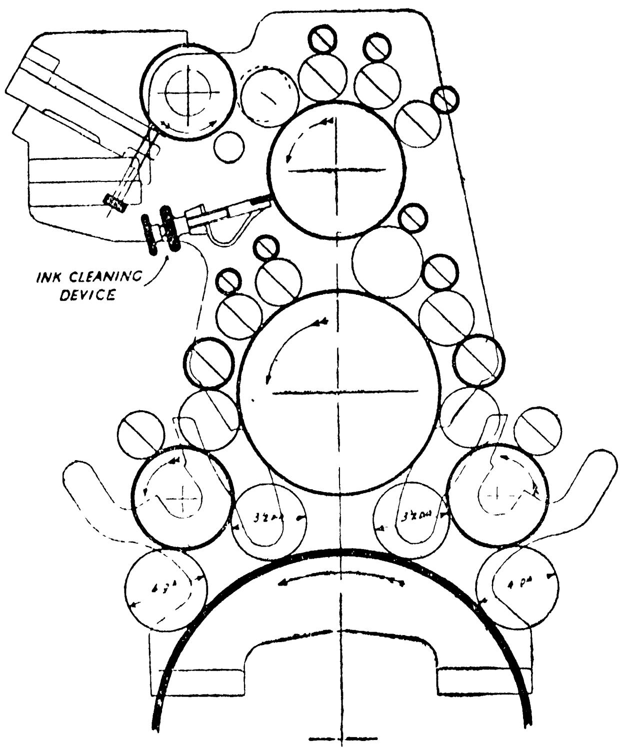


FIG. 63.

Inking arrangements on the Mann 'Fast Five' Two-colour offset machine. The rollers with a diagonal line through them are required only for printing work with heavy solids.

resistant to oils, solvents, and driers, and unaffected by temperature; leather rollers have a seam which may cause marks. The ink is supplied to the rollers on the pyramid system, and damping arrangements are similar to those on the direct litho rotary. Delivery usually takes the form of one or more gripper bars on an endless chain.

There are rotary offset machines for printing in one or more colours and for perfecting the sheets, and those equipped with

automatic feed and delivery are capable of high speeds. This type of machine may eventually be responsible for daily newspapers in colour, as units may be combined on the principle of the letterpress rotary.

The Mann Offset Machines, universally known as the 'Fast Five' (two-colour) and 'Fast Three' (single colour) can be regarded as outstanding examples of the modern type of offset machines. They have won wide recognition for their fine printing qualities combined with high speeds and maximum output. The unique inking system (Fig. 63) is designed to 'break up' the ink and distribute it equally to both front and back edges of the print and the unequal diameters of the four forme rollers ensures freedom from repeat marks. The basic design of both is similar to that of the 'Fast Five' (Plate XVIII) and is self-explanatory. It should be noted that it is built on the unit-construction principle providing for any number of additional units.

To maintain successfully the high speeds, it has a low centre of gravity and the sheets are fed and delivered printed-side-up. Swing arms take the sheet from the layboard and transfer it to a feed cylinder which in its turn gives it to the impression cylinder grippers which hold it until both colours are printed, prior to transfer to the delivery chain grippers, the sheet on its way passing over a slow-down suction roller for perfect deposition on the delivery pile. A trap delivery for waste sheets is available.

Perfect registration of colours at all and varying speeds is achieved mechanically and the printing pressure—adjusted by parallel settings from one position even whilst machine is running—is set on precision lines.

Automatic water control (hydrostatic), oiling system, and washing-up devices are standard equipment, and there are many exclusive features on these machines all tending to reduce the change-over or make-ready (i.e. non-productive time) to the minimum; they are too numerous to detail here.

In 1870 Robert Barclay took out a patent for using an offset medium on an intermediate cylinder between the stone and impression cylinder for printing on tin. Offset printing on paper was initiated by Rubel in 1906 and progress was considerably developed when metal plates took the place of stone and when the rotary principle (which quadrupled the speed) was adopted. The resilient rubber blanket which transfers the ink from the printing surface enables rough-grained paper to be used. The damping of the stone or plate in direct lithography tends to alter the size and behaviour of the paper; in offset less damp is necessary (the paper never comes into

contact with the damp stone or plate), the machine requires less power to drive, and uses less ink.

For printing photogravure there are three kinds of machines; a sheet-fed machine which prints from thin copper plates clamped and screwed around the cylinder, in which there is a gap. When the cylinder is in the press, the ink is conveyed to it by a rubber roller (in rotary machines it revolves in the ink duct), and the superfluous ink is removed by a doctor blade, a band of flexible steel stretching along the length of the cylinder at an angle and having a reciprocating side-to-side movement. By pressure the doctor blade scrapes away

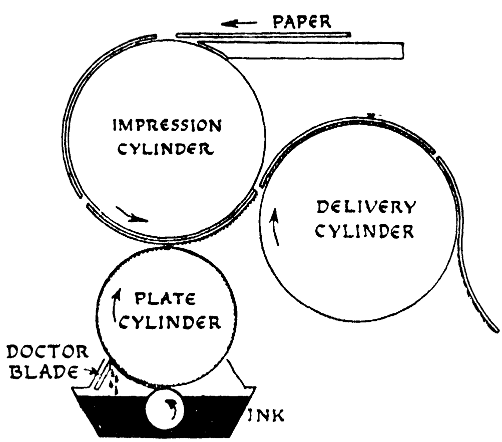


FIG. 64.

Principle of rotagravure machines. The plate is charged with a volatile ink, the doctor blade scrapes away excess ink from the plate, the ink is pulled out of the recesses of the plate by contact with the paper.

all the ink except that in the etched cells. The pressure of the paper against the plate cylinder by the rubber-covered impression cylinder transfers the ink to the paper, the deeper cells transferring more ink than the shallower cells, thus giving the gradations of tone. As the doctor blade is not in contact with the cylinder for the complete revolution, because of the gap, the speed of the machine is limited, but it is useful for smaller editions.

Two kinds of sheet-fed machines are used with copper cylinders; one is a two-revolution press which has an impression cylinder twice the size of the printing cylinder, and a single revolution machine where both cylinders are of the same size.

All these machines have rubber-blanket impression cylinders, and

air-blowing is used to assist drying. Extended delivery (which allows the sheet to travel as far as possible) is also used to assist drying. Contrast in the tones of the prints can be controlled locally by the use of air blasts on the printing cylinder immediately above the doctor blade.

Rotary photogravure machines (Plate XIX) consist of a steel frame containing impression cylinders and printing cylinders; ink duct and doctor blade; heating, cooling, and blowing devices; tension rollers and adjustable bearings. The impression cylinder is a small rubber-covered roller placed under pressure between a larger steel roller and the printing cylinder. The ink duct and doctor blade are in effect identical with those on other machines, but heating, cooling, and drying arrangements may be more elaborate. The heating cylinder consists of a large drum around which the web runs while blasts of air are blown on the outer surface. Water-cooled rollers are placed to cool the web immediately after it leaves the heating drums. Numbers of units can be run together, and colour work can be printed in one operation; for example, four colours may be printed on both sides of the paper from eight cylinders and delivered quite dry from the machine. Gravure inks have a spirit base and depend mainly on evaporation for their drying properties.

The introduction of an enclosed ink fountain is considered an important advance. The ink is circulated by means of a pump and the cylinder is inked direct without a roller feed. The doctor blade on one side of the casing and a strip of metal on the other complete the enclosure. As only a small area of the cylinder is exposed to the air, little evaporation takes place; an ink solvent of a highly volatile nature can be used, drying arrangements can be simplified, and speed increased about four times.

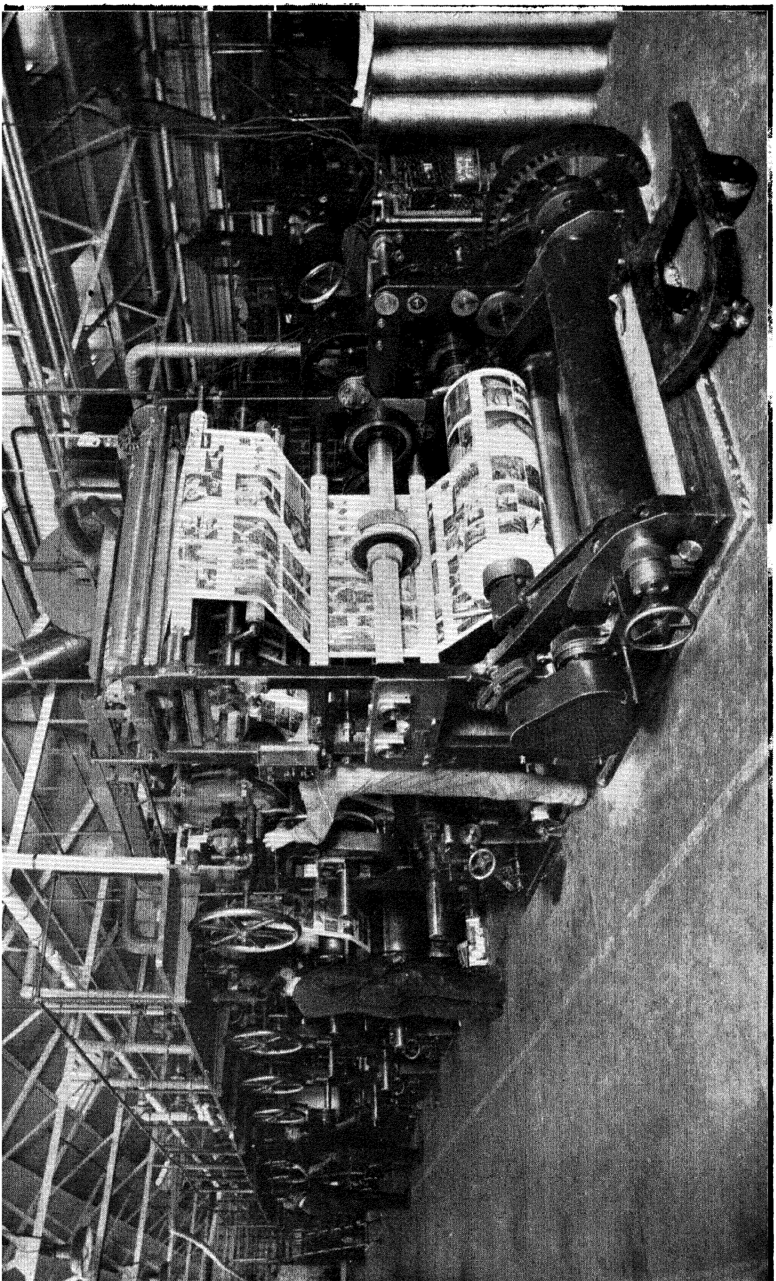
Rotagravure has been preferred recently to other printing methods for illustrated magazines and newspapers. The *Illustrated London News* was the first to adopt it in this country, and there are papers in various parts of the world printed by this method. In the United States it is widely used for weekly supplements, notably by the *New York Times*. The future of rotagravure for newspapers depends on some way of increasing the printing speed to that of the letterpress rotary or of rapidly duplicating the cylinders. For supplements, the rotagravure reels could be re-reeled and passed to the letterpress rotary to combine with its product in the folder. The difference in speed does not allow tandem running.

The superiority of letterpress printing for continuous reading has

already been discussed, and there is no doubt of the superiority of photogravure for illustration on cheap papers. To obtain the best from each method, a combination machine has recently appeared in America consisting of interchangeable gravure and typographical printing units which may be assembled as required. The construction of the press provides for about seventeen feet of travel between each printing, so that heating and cooling for drying the sheet can be applied.

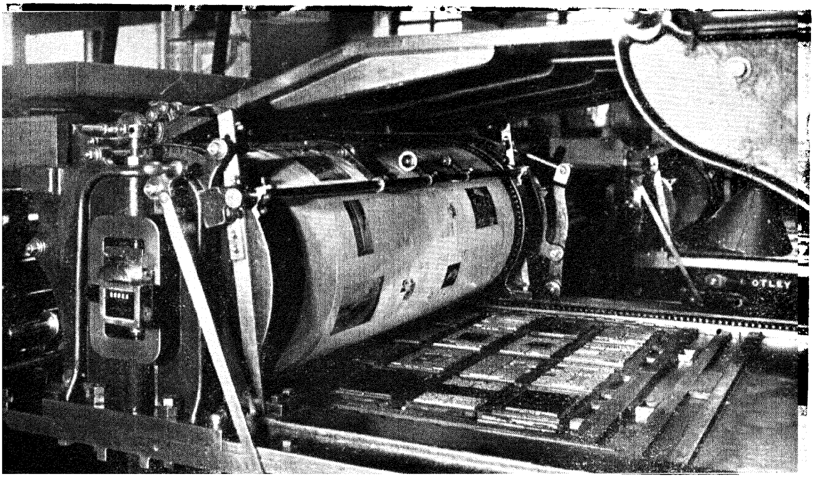
Make-ready

The purpose of letterpress printing is to place a film of ink from the inking arrangements on to the raised surface and to transfer the ink to the paper by force and pressure, so that the impression will be even, clear, and distinct, neither too light nor too heavy. Make-ready is the process of preparing, on the press, the forme and platen or cylinder to effect this object. Few formes or plates offer a uniform resistance over the whole of their area. Large type offers more resistance than small type; a solid mass of small type offers more resistance than a single line of the same size. Similarly, the solids of a half-tone engraving need more pressure than the dots which make up the high-lights. For satisfactory printing, then, the inked printing surface must be brought into contact with the paper at the correct force and pressure. It is not possible to print a piece of paper between the type metal of the forme and the metal cylinder of the press. In cylinder machines a portion of the cylinder is recessed to allow for the insertion of materials that will accommodate themselves to the printing surface without damaging it. Dressing is the term used to describe the placing of a number of sheets around the cylinder or platen to get an impression from the forme on to the paper. The dressing on the cylinder or platen takes up unevennesses in the printing and impression surfaces and provides compressible 'packing' by which the total pressure may be controlled by adjustment. Materials used include paper of varying degrees of hardness, felt (used, for instance, on letterpress rotary machines), and rubber (used on both offset and gravure machines). The packing comes between the forme or plate and the platen or cylinder. On letterpress cylinder machines where, for instance, there is 60 mm. between the bearers and the face of the cylinder, 77 mm. of newsprint or 66 mm. of super-calendered paper would give 600 lbs. pressure per square inch; 71 mm. of newsprint or 63 mm. of super-calendered



A Re-reeling Rotary Gravure Machine at the Sun Engraving Works, Watford.

PLATE XX



Forme on the bed of a letterpress cylinder machine.

Half-tone block printed without 'make-ready.'

The same half-tone block printed after 'make-ready' is completed.

paper would give 200 lb. pressure per square inch. In practice, more than one kind of paper is used, as the packing must be adapted to the nature of the forme.

A typical hard packing might consist of three sheets of a specially treated manilla paper (to resist oil and moisture) as a permanent foundation next to the metal of the cylinder, one sheet of untreated manilla, six sheets of book-printing paper, one sheet of treated manilla, and a final sheet, called the strike sheet or draw sheet. Hard boards and super-glazed calico are also used for dressing cylinders. A hard packing gives sharp impressions, the paper does not tend to fold over the edges of printing surfaces, shows least indentation, and needs less ink; but it is less resilient than soft packing and does not easily take up unevennesses in the forme. It is almost invariably used for the best printing such as bookwork and work with half-tones. The making-ready, however, needs to be more carefully done and to be more selective; this adds to the time necessary before the actual printing commences.

Medium packing (which uses both hard and soft papers on the cylinder) is used for general printing. It does not show undue indentation, transfers the ink well, adapts itself to the printing, and takes less make-ready time.

Soft packing, which uses softer papers such as newsprint, pulpy papers, and (for poster work) rubber sheets and blankets, offers little resistance to the printing surface, and irregularities in the forme are less noticeable. Indentation is easy, and although more ink is used, time is cut down and the ink prints solid.

The forme must first of all be brought up to the height of type (·918 in.) on the bed (which may be worn), and then be made level for correct pressure on its various parts. There are many causes of different levels in formes, such as a mixture of old and new types, different heights of stereotypes and electrotypes cast from type of different amounts of wear, variation in wood mounts of blocks, and so on. The machine applies force to the forme as it runs under the cylinder, but the pressure must be adjusted to suit the resistance of various parts of the forme. These defects in the forme are corrected by underlaying, interlaying, and overlaying (Fig. 65). Larger defects are effected by underlay and interlay, smaller defects by overlay and local patching.

Underlaying is the placing of paper or card under the forme and under the mounts of blocks to bring them up to the required level.

Interlaying is used between the mount and the half-tone block to correct local inequalities of pressure due to inaccuracies in the mount or plate and to regulate the pressure to the tones by exerting the pressure through the plate and reinforcing it from below. Prints are taken of the block, and a two-ply, three-ply, four-ply, etc., build-up is made by cutting away parts of the prints according to the tones of the plate, pasting them in register or coincidence, and placing the build-up between the plate and the mount, also in coincidence with the picture on the face of the plate. This method is mainly used in newspaper printing to 'bump' parts of the plate, as make-ready is

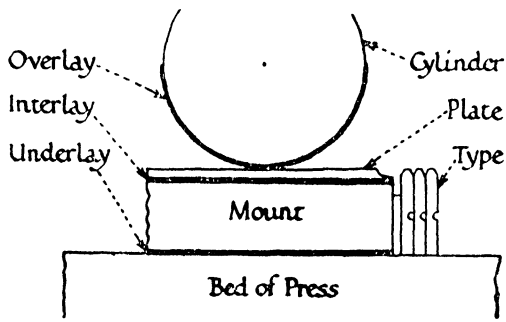


FIG. 65.
Illustrating the position of the different kinds of 'make-ready.'

not possible on rotary machines. The interlay (which sometimes consists of etched metal) is placed between the plate and a metal mount and placed in the type forme. The pressure of the stereotyping process causes the interlay to raise the shadows and to relieve the high lights. These varying heights impart a contour to the printing surface, and the varying pressures are taken up by the blanket of the impression cylinder.

An overlay is similar to an interlay but is placed on the cylinder beneath some of the sheets of the packing. Patching for reducing or increasing pressure locally is also done on the cylinder, the patched sheet being similarly 'sunk' or buried under the packing before printing. If a proof be taken with a slightly heavier impression than necessary, the back of the paper will indicate defects in pressure, and spots may be patched up with ~~tissue paper~~ as required. Overlays are of various kinds: hand-cut of various plys, mechanical chalk overlay, etched metal relief overlay supplied by the process-engraver, and gutta percha relief overlay. The overlay when placed on the

cylinder must, of course, be in perfect register with the block in the forme.

A hand-cut four-ply overlay would be made by taking four proofs of the block, cutting out the high-lights in the first proof, cutting out the medium and light shadows in the second proof, cutting out the light, medium, and heavy shadows in the third proof, leaving the solids only in the fourth proof, pasting all four sheets accurately over one another, pasting the whole in register on the cylinder.

The chalk overlay is made from a piece of paper stained pink coated with chalk on both sides. By printing an impression on a separate piece of paper (in a platen machine), placing the chalk overlay on it while it is wet and taking a further impression on the chalk overlay, a set-off impression is obtained on one side and a direct impression on the other. These prints are made with a resist ink, and the overlay is then etched. The etching affects the parts not so much covered by the ink (i.e. the lighter parts) in proportion to the quantity of the ink on the other parts. The loose chalk is brushed away, the etched overlay washed and dried, and placed on the impression of the block on the cylinder. It is, of course, superior to the hand-cut overlay as it translates the gradations of the half-tone picture into correct degrees of pressure.

Overlays are also made by dusting a sheet of paper with talcum powder, taking a proof, dusting the proof with powdered resin, heating it until the resin fuses, and then scraping away parts of the fused resin in accordance with the light and shade of the half-tone. It is a quick and cheap method.

If there were no inaccuracies or weaknesses in printing machine construction and no dimensional inaccuracies in the printing elements, make-ready could be largely eliminated by using new type from carefully maintained type-setting machines and precisely made metal-mounted engravings. Correction of pressure distribution, however, cannot be wholly abolished as it is inherent in the letterpress printing process.

The normal procedure for making ready on a cylinder machine is as follows: the forme is securely locked up on the bed of the machine. It must be square and positioned roughly to suit the paper as it is fed and to coincide with another sheet if the sheet is being 'backed up' or perfected or printed in other colours. Minor alterations in positioning are adjusted by the alteration of the guides by which the sheets are fed into the machine. Much trouble, of course, is saved if the forme is right before going to the machine by lining up pages

correctly and cutting interlays. In modern printing offices a table with a plate-glass top lit below by electric lighting and provided with sliding steel rules down and across the glass surface is used. With this device, proofs may be exactly checked and tested for accuracy before going to the machine. For colour work, thin paper proofs may be superimposed and viewed through the light. After adjusting the ink control, an impression is taken for examination. Underlays and interlays are then made, and then overlays on the cylinder. The overlay sheet is then buried, and the top sheets secured to the cylinder to prevent sagging or slipping and to protect the overlays and the patchings. The delivery mechanism is then set, the ink flow adjusted to suit the job, and all is ready for printing.

In colour work the formes are printed in the order of yellow, red, and blue, although the greatest printing area is generally used to fix the position on the sheet and is used as a 'key' forme. When the position is decided, proofs are taken, the forme is then replaced by the one to be printed in the lightest colour, and the position obtained from the key proofs. Formes are registered (i.e. printed in coincidence) by moving furniture and leads in the forme, moving the forme on the bed, or unmounting the plates and remounting them at the correct angle.

On two-colour machines there is an impression cylinder for each forme. Both cylinders are dressed and the key forme placed on the first bed. Blocks are corrected, the forme is secured to the bed, the guides are positioned, and make-ready completed. The second forme is then placed on the second bed and the make-ready completed. It is then made to register with the first forme. In three-colour work the yellow is usually printed on a single-colour machine and the red and blue on a two-colour machine. In four-colour work, the red and blue on one machine, and the yellow and black on another machine.

The make-ready of half-tones on rotary letterpress machines has

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PLATE XXI.

(*Left*) Full-page advertisement, original in subdued colour, from an American periodical (1943). Design, technique, and typography derived from the 'modern' movement. Few could avoid reading the wording linked with such illustration.

(*Right*) Page advertisement from an original in full colour from an American periodical (1943). Reveals the controlling hand of the 'art director' in its wide range of modern techniques. All the pictures (except the package) are reproduced from colour photographs. The hand-lettered headlines are similar to a fattened 'modern' type but permit closer fitting than type. To preserve the freedom of composition the paragraphs of type matter are set in uneven lines and line-up on the left only. Note how the eye is led from all points to the cigarette packet.

PLATE XXI


THE SATURDAY EVENING POST
Women in the War
Wherever you find the Services
you find Camels
Steady Nerves
For Steady Pleasure
Camels
FIRST IN THE SERVICES

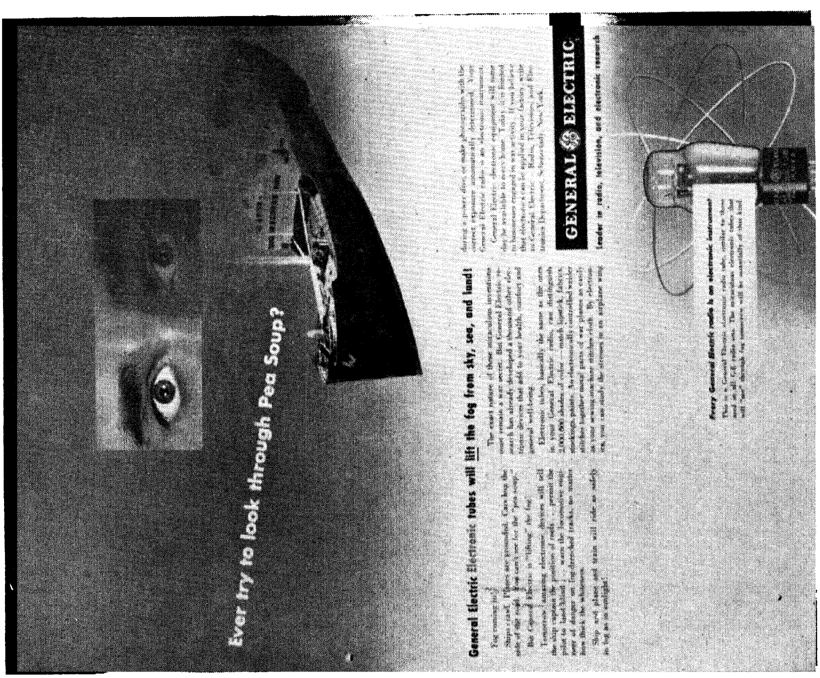
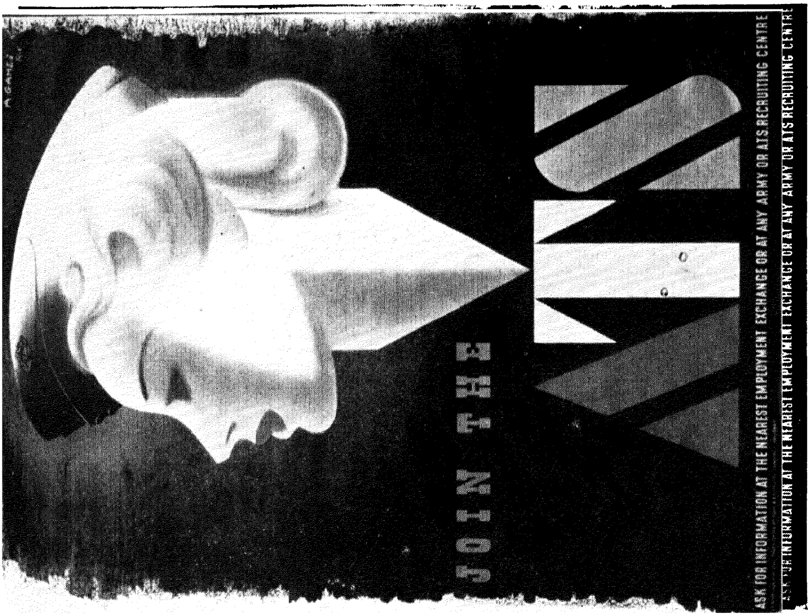
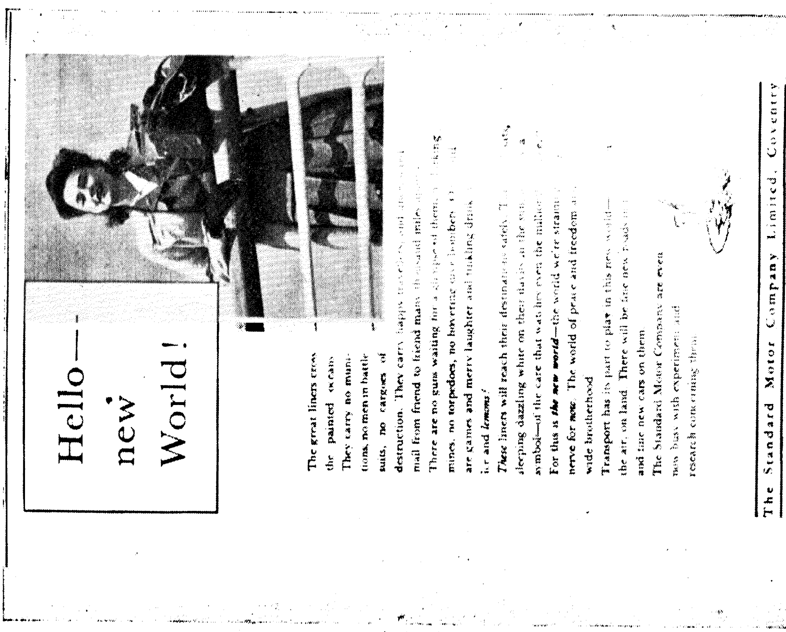

Ever try to look through Pea Soup?
General Electric Electronic tubes will lift the fog from sky, sea, and land!
GENERAL ELECTRIC
Leader in radio, television, and electronic research

PLATE XXII


JOIN THE
ATS
ASK FOR INFORMATION AT THE NEAREST EMPLOYMENT EXCHANGE OR AT ANY ARMY OR ATS RECRUITING CENTRE
ASK FOR INFORMATION AT THE NEAREST EMPLOYMENT EXCHANGE OR AT ANY ARMY OR ATS RECRUITING CENTRE
A. GAMES


Hello— new World!
The Standard Motor Company Limited, Coventry

already been described. One of the principal troubles in newspaper printing is strike-through (the penetration of ink to the other side of the paper) and set-off. When half-tones can be printed on every page without these troubles the greatest problem of high-speed newspaper printing will have been solved. Set-off can be largely overcome by quicker drying inks and ink-repellent blankets. The problems of paper breaks and of correct temperature for ink-working have already been mainly overcome.

On direct litho machines the cylinder is dressed with a blanket over which is stretched a sheet of American cloth or thin rubber. The stone or plate is placed on the machine bed or carriage and levelled by means of packing. Plates are usually mounted on iron or steel bases. The base of the carriage is then lowered, the cylinder run over the stone or plate, and the carriage raised so that the stone or plate is in contact with the cylinder. It is then adjusted for the correct amount of pressure and flow of ink and water. The position on the paper is obtained by moving the stone or plate or the guides on the feeder-board. The stone or plate is then locked firmly on the carriage. A certain amount of local make-ready is possible on the cylinder to adjust pressure. In direct litho rotary machines the plate is secured around the printing cylinder by movable clamps and screws. No extra covering is used on the impression cylinder, and a brush is fitted to remove fluff and to smooth the sheet.

Litho offset flat-bed machines are not often used for editions of more than 5000 as they are not considered to be economic. In offset printing there is no indentation of the paper and no need for bringing certain parts up or down as in letterpress printing, and only the lightest pressure is needed. On litho offset rotary machines making ready consists of setting the cylinder pressures, obtaining the correct position for the paper sheet or reel, and adjusting the ink and water flow. The interposition of the rubber blanket controls impression. The rubber is resilient and gives full value of every detail to the paper. If a rough paper is used, the rubber reaches every interstice without exaggeration of the image. The ink must be full-bodied;

PLATE XXII

(*Left*) Double-column 'goodwill' advertisement from an English newspaper (1942). Its effect is secured through the greatest economy of means. Set entirely in the Baskerville type.

(*Right*) Poster by Abram Games. A design which fulfils all the requirements of a modern poster. Its message is conveyed instantaneously.

[Block by courtesy of *Art and Industry*.]

fluid ink produces lifelessness. A small amount of ink only is required, and the rubber transfers this completely to the paper, which needs no damping and therefore is not subject to stretching and curling troubles on this account. Pressures, however, must be obtained with micrometric precision, and blankets sometimes need to be patched wherever they are worn. They may then be used for any other plates in which the printing area is identical.

One of the troubles in all litho printing is 'tinting-up' or scumming, which is seen on the print as minute spots of colour due to the imperfect neutralizing effect of the water on the plate• or to particles of grease which pick up ink.

In gravure printing, in which rubber blanket impression cylinders are also employed, a certain amount of make-ready can be used although not to the same extent as in letterpress printing. A few sheets of paper are used to ease the pressure from margins and to concentrate it on the image itself; overlays, interlays, or underlays are not used. Contrast can be controlled locally by blowing jets of air on to the cylinder immediately above the doctor blade, so that by localizing the blowing, a kind of make-ready is achieved.

Automatic Feeders

Hand-feeding was until fairly recently a handicap to the manufacture of faster-running presses as there was no purpose in increasing speed while the rate of production was determined by hand-feeding. Since the introduction of automatic feeders and delivery mechanisms, much greater speed and output has been possible. The earlier types of automatic feeders suffered from the disadvantage of not being an integral part of the machine, but with the increased tendency towards built-in feeders, most of the troubles of auto-feed attachments have been overcome. Nowadays several hours' work can be placed on the feeder, and the handling of work in small quantities, which wasted time and spoilt work, is avoided. One of the bugbears of printing is set-off or the transference of ink from one sheet to another by pressure (see p. 148). This would seem inevitable in a large pile of delivered printed sheets, but in practice this rarely occurs as the cushion of air between the sheets remains there sufficiently long for most work to become surface dry.

Automatic feeding is effected by the use of pneumatic suction, air blast, or friction, and sometimes they are combined. The sheets of paper on the loaded pile are sucked up singly and separated by air

blast (which also removes dust and fluff), passed forward by strokers, combers, or rollers, and carried to the guides or lays on running tapes, to be taken by the grippers of the machine. The sheet is positioned to the guides by stroker devices. A wrongly fed or damaged sheet or a 'miss' automatically checks impression, as the sheet acts as a non-conductor and, when fed correctly, prevents electric current actuating the switch-off mechanism. There are of course many different types of automatic feeders. The continuous pile feeder allows a second pile of paper to be loaded while the first pile is being fed to the machine.

With a pile delivery the product of many hours of machine running can be piled on a table which is automatically lowered as the pile increases, and, when required to be removed, is wheeled away on a trolley. The sheets are delivered, printed side up (so that the machine minder may examine them), on to a sinking board, each sheet being straightened on the pile by an automatic jogging device.

With regard to the rate of production of printing machines, many factors have to be considered, such as the size of the sheet or forme, the nature of the work, the ink, the make, age, and condition of the machine, and the individual skill of the pressman. The following figures are therefore merely approximate, and the capability of a machine does not necessarily mean that it can be satisfactorily exploited, for quality must always be considered.

LETTERPRESS MACHINES

Platen	1000–1500 per hour
Platen (auto-fed)	3000–3500 ,, ,,
Flat-bed	1000–1500 ,, ,,
Flat-bed (auto-fed)	2000–4000 ,, ,,
Rotary (sheet-fed)	4000–8000 ,, ,,
Rotary (from reel)	up to 21,000 revs. ,, ,,

Some idea of the output of the letterpress rotary can be gathered from the circulation of American weeklies. The *Saturday Evening Post* has an edition of three million, a large part of it printed in four colours. *Life* has a circulation of two million, and has four-colour letterpress advertisements. The *New Yorker* prints 130,000 copies which are sheet-fed. In England the *News of the World* has a circulation of five million and the *Radio Times* about three million.

Lithographic Machines

Direct Flat-bed	1000–1500 per hour	
Rotary	2500	,, ,,
Offset Flat-bed	1250	,, ,,
Rotary (sheet-fed)	2000–5000	,, ,,
Rotary (reel-fed)	up to 10,000 revs.	,, ,,

Gravure Machines

Rotary (sheet-fed)	3000 per hour	
Rotary (reel-fed)	up to 10,000 revs.	,, ,,

Set-off

Set-off is caused by free undried ink and the shifting or rubbing of the printed sheet as it settles on the delivery or as it is placed on other printed sheets or web. In work printed in heavy colour the printed sheets may be interleaved with blank sheets so that any ink which sets off is taken by the interleaves and not on the work. This operation, however, slows down output and increases cost.

Anti-set-off sprays are now used to prevent set-off. The earlier devices used finely powdered talcum powder, which was blown on each sheet as it was printed by compressed air. The dust set up in the air, however, proved harmful to pressmen, as fine talcum consists of finely powdered clay in irregular jagged particles, and produces a similar effect to coal-dust inhaled by miners. Molten paraffin wax, electrically heated to a fluid state and atomised by air pressure into fine particles (chilled in moving from the nozzles through which it is sprayed on the sheets), and liquid sprays of gum arabic or starch are now used. Paraffin wax is inert and is not readily assimilated by the human system, and constant inhalation of wax particles gives an impervious coating to the membranes in the lungs, and thus impedes free oxygenation of the blood stream. Gum arabic and starch are easily assimilated by the system and are harmless when inhaled.

The action of the sprays is identical in every case. Although very fine, the particles of powder, wax, or gum hold the sheets sufficiently apart and prevent contact with subsequent sheets. As the solution is atomised by the air blast, the liquid evaporates or the wax solidifies, leaving the particles on the wet printing.

CHAPTER XIII

PAPER AND INK

ALTHOUGH introduced into Europe in the twelfth century, paper-making received a tremendous impetus through the invention of printing three centuries later. Paper provided a less costly, a more supple, and a more accessible medium than vellum or parchment. It had, however, to overcome the objection to its fragility and the jealousy of the established vellum and parchment trade. The dependence of the printing press on supplies of paper-making material has often set problems. Although paper is made to-day from a wide variety of materials, early papers were made mainly from rag, and the supply was not always adequate. In the eighteenth century, for example, legislation forbade the burial of the dead in shrouds made from cotton or linen, and at the end of the same century some paper mills were forced to discontinue owing to a shortage of rags, said to be due to their wide use for bandages in the wars. The paper-maker to-day can afford to have no regrets for the days when ladies wore several petticoats. His attitude might perhaps be better expressed in the words of an anonymous poet:

See that spruce against the sky?
That is 'Harper's' for July;
And the poplar in the canyon
Is the 'Woman's Home Companion'!

Paper consists mainly of cellulose, a chemical substance, more familiarly known in the paper trade as fibre, obtained when vegetable substances are treated with caustic soda or other suitable re-agent so that all resinous and non-fibrous elements are dissolved out. Other substances are added to the cellulose in paper-making for various purposes.

Paper is made from linen, cotton, esparto grass, wood, hemp, flax, bamboo, jute, straw, bagging, rope, string, and waste paper.

The best papers are made from rag. The rags are sorted, cut into small pieces, boiled in caustic soda to remove foreign matter, washed and broken up in a beater or hollander to semi-pulp or 'half stuff,' and bleached in chloride of lime. This pulp is then ready for the paper-making machine.

Esparto grass is received in bales and yields 40 to 50 per cent. of

cellulose to its dry bulk. The fibres are short, thin, and smooth, and only about one-twentieth of the length of cotton. The grass is dusted, conveyed to a boiler and treated with caustic soda. It then goes to the hollander, is bleached and drained, and treated in another machine to eliminate impurities.

Straw yields 40 per cent. of cellulose. It is chopped, dusted, and then beaten in the same way as esparto. Bamboo, which is considered as useful as wood, is crushed and chopped, then boiled to remove the starch. It is used mainly in India.

Wood provides the bulk of the paper used to-day. Wood pulp is of two kinds: mechanical and chemical. It is imported from the U.S.A., Canada, Scandinavia, and Russia, from pulp mills usually situated near the timber tracts. For mechanical pulp the logs are ground with water to semi-pulp and made into boards and sheets for export to the papermaker. Newsprint consists of about 75 per cent. mechanical and 25 per cent. chemical sulphite wood pulp. Mechanical wood pulp rapidly discolours under the action of light and the structure breaks down, causing the paper to become brittle and finally to disintegrate. Its weakness is usually supported by a certain amount of higher grade pulp. It is, however, more opaque and of greater bulk than sulphite pulp, but without its strength.

Chemical wood pulp is made by reducing the logs to chips, sorting them, and chemically treating the wood to reduce it to a fibrous state. Soda wood pulp, from poplar, aspen, and bass wood, is treated with caustic soda for making soft and bulky papers for books, magazines, and writings; sulphite wood pulp, from coniferous woods, is treated with calcium or magnesium bisulphite for use as an admixture in news and cheaper printing papers, which are harder and more transparent than soda wood pulp papers; and sulphate wood pulp, from spruce and pine wood, is treated with sodium sulphate for the manufacture of tenacious and strong kraft brown paper. Wood yields from 60 to 85 per cent. of cellulose.

The non-fibrous additions to paper consist of minerals mixed into the pulp, minerals applied to the surface, sizing (which is mixed into the pulp or applied to the surface), and pigments or dyes to 'whiten' the paper or to give it a colour.

Filling or loading is used to fill inter-fibrous pores, to improve colour, and to increase opacity. Loading is added to the pulp in the form of china clay (kaolin), calcium sulphate (satin white or pearl hardening), agalite (a kind of asbestos), talc, titanium oxide, and barium sulphate (barytes or *blanc fixe*).

Minerals applied to the surface include calcium sulphate, barium sulphate, and china clay, which are coating mixtures and make a smooth level surface for half-tones on art or coated papers. These mixtures include casein, gelatine, glue, and starch as carriers and adhesives.

Sizing materials (which are used to control ink penetration, to increase rattle and stiffness, to improve strength, and to impart cohesion to the fibres) include resin size (an alkaline emulsion precipitated by the addition of alum), animal gelatine size (used in surface sizing to resist the penetration of writing inks and to permit erasures), starch (which lowers the cost of coating mixtures and prevents fibres from plucking), and casein (a tacky water-resistant skimmed-milk product which is also used as an adhesive in coating mixtures). Casein coating is suitable for lithographic papers; starch is soluble.

Suitable pigments give fast colours to light papers; dyes are also used for improving the colour of white papers (red and blue to reduce yellow tinge) and colouring the pulps for coloured papers.

Impurities in paper of chemical origin often give subsequent trouble. Free acid will tarnish bronzing or affect steel if wrapped in a paper where it is present, sulphur residues will tarnish metals, alum or acid will neutralize parts of a lithographic plate and cause scumming.

There are two kinds of paper, hand-made and machine-made. Genuine hand-made paper is made by a vatman who dips a mould into a vat of pulp consisting of pure rag fibres and takes up sufficient to make one sheet. The mould is a framework of wood into which are set thin transverse wooden bars, perforated with holes. A frame called a deckle is used with it, and when placed on the mould provides an edge to prevent the pulp running off and also determines the size of the sheet. The surface of the mould has either a *laid* wire sheet or a *woven* wire cloth—the laid is the older form. This sheet is sewn with wire to the bars. The vatman shakes the mould with the pulp to secure an even thickness to the sheet, and passes the mould (without the deckle) to the coucher, who presses the mould on to a pile of felts. The film of paper adheres to the felt. The pile of alternate sheets of paper and felt is put into a press. The paper is taken out of the press, piled, and pressed again. The sheets are stripped apart and are ready for sizing, then dried in the drying loft. Smooth finish is given by pressing between metal plates.

Machine-made papers are made on a highly developed mechanism of various parts (Fig. 66). These parts are the wet end, the presses,

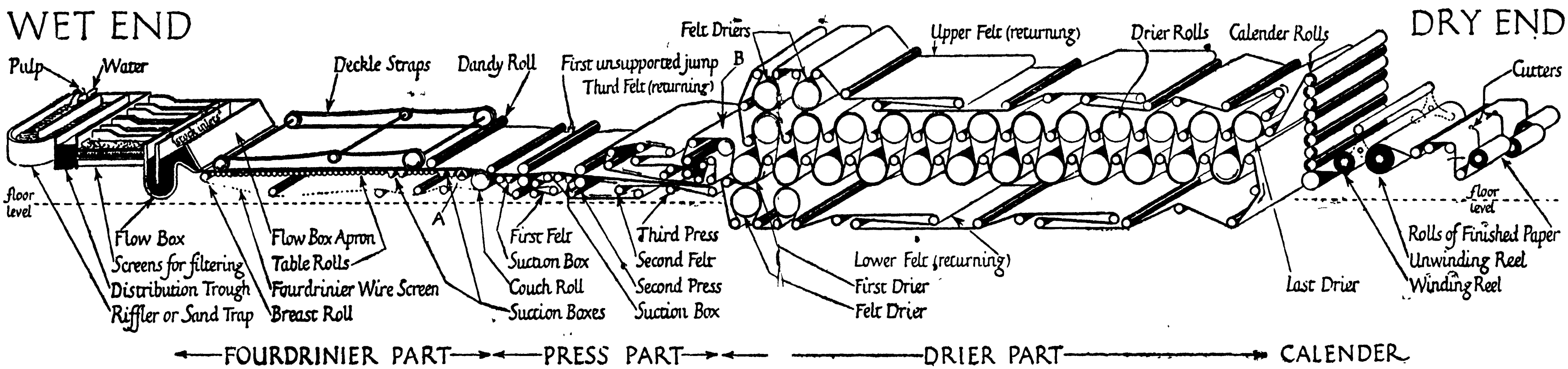


Fig. 66.

How Paper is Made on the Fourdrinier Machine.

At the wet end the stock consists of $\frac{1}{2}$ to 4 per cent. of pulp and 96 to 99$\frac{1}{2}$ per cent. of water. It is fed to the machine from a regulator box. The frame which supports the table rolls and suction boxes (which in turn support the continuous wire screen of 55 to 75 wires per inch) is hinged at A and vibrates laterally, effecting even distribution and interweaving of the pulp fibres. Heavy rubber deckle straps prevent the pulp stock from flowing off the edge of the wire screen.

The dandy roll is the first to press and smooth the stock from above. The paper is watermarked by embossing the surface of the dandy roll with fine wires. The paper now takes its first unsupported jump. At B the stock is still 60 to 70 per cent. water.

The felts assist to thread the paper and to press it against the hot cylinders. The rolls are steam-heated from within. The pressure of the calender rolls gives a smooth hard finish. (Paper is not always calendered.) At the dry end there is only 7 to 10 per cent. of water in the finished paper.

the dryers, and the calenders. The pulp or 'stuff' comes from the beaters to large vertical tanks with stirrers and paddles. It is filtered and strained, and flowed on to a travelling wire frame over an apron of waterproof cloth. The fibres tend to dispose themselves in a direction parallel to the onward flow. This is the reason why paper made by machine will tear more easily in this direction, whereas hand-made tears evenly wherever it is torn. The width of the paper web is controlled by deckle straps or endless india-rubber belts. The wire is of fine mesh, and the paper flows on the wire in a diluted state consisting of 98 per cent. water. The water is extracted by the vacuumatic action of rollers beneath the travelling wire and suction boxes towards the end of its travel. The wire frame is oscillated continuously to cause the fibres to intertwine or 'felt' with each other. Between the suction boxes is the dandy roll, a light skeleton wire-mesh drum either of spaced ribs with crosslines for laid papers or of woven design for wove papers. On this wire is stitched or soldered the watermark worked in wire. The dandy roll also serves the purpose of covering or closing up the surface of the paper web. The watermark is given by the raised wire pushing away part of the fibres in the web, thus thinning the paper at the points of contact.

At the end of its travel the paper comes into contact with two large hollow cylinders, the upper one covered with felt; these couch rolls remove superfluous moisture. Suction cylinders are also used. The web then meets the wet presses, a pair of cylinders which extract more moisture by pressure. A blunt blade removes adhering fragments of pulp, and the web is now conveyed to a series of steam-heated drying cylinders, endless dry felts keeping the web tight and even, and thence to another stack of cylinders or calenders which gives smoothness to the surface of the paper.

The following are the commoner kinds of paper, and their qualities are largely due to the finish which is given to them:

Newsprint is made from mechanical wood pulp and some chemical wood pulp. It may be glazed or unglazed and supplied in sheets or reels.

Antique is usually, though not always, a roughish, bulky, porous paper with little loading. Featherweight antique is a common kind.

Machine Finish has medium smoothness, and implies the finish imparted to the web during its travel through the machine and without any further treatment.

Super-calendered paper has a high smooth gloss which is given to

the paper by passing it, after damping, through a stack of cylinders or calenders which polish it.

Art paper is given a coating of china clay or other substance after making. English art paper usually has an esparto base. The paper on the cylinder revolves in a trough and then through brushes which distribute the coating evenly. If left uncalendered, it has a matt surface. Varying degrees of calendering give less or more glossy or 'enamelled' finishes.

Imitation Art papers are loaded in the beater. They are afterwards sprayed with water before passing through the calenders. They are a cheaper form of art paper, smooth and opaque. All art papers crack badly when folded.

Bank or *Bond* papers are made of rag and chemical wood. They are tough and smooth and are used widely for letter headings.

Vegetable Parchment is water-and-grease-resisting. This paper is parchmentized by running it, after making, through sulphuric acid baths and through rollers between the baths, which presses the liquid into the paper and causes a chemical action to take place and to make the paper water-resisting. The finished paper is acid-free.

Greaseproof papers are identical with ordinary sulphite papers. The paper is hydrated by excessive beating, which makes it brittle but greaseproof.

Machine Glazed (*M.G.*) *Litho* papers are glazed on one side, the other side being left rough for pasting up as they are used for posters.

Blotting paper of the best kind is made of rags and left unsized. Poorer qualities are made from mechanical wood.

Duplicator paper is unglazed writing paper with some sizing.

Writing papers are sized by hand or machine, after the paper is made, to resist the fluidity of writing inks. Several finishes are given to them.

Manilla paper is made from strong unbleached sulphite pulp and not from manilla hemp as previously. It is used on letterpress printing cylinders and for tags and labels.

Boards are of four kinds, pasteboard, pulpboard, ivory board, and coated board, and are either thick paper or a combination of two or three papers. Pasteboards have a central core and are surfaced with a paper suitable for printing. They range from $\frac{1}{85}$ in. to $\frac{1}{16}$ in. thickness. Pulpboards are actually thick paper of one substance throughout. Ivory boards are made by pasting one or more sheets together. They

are translucent, clean, and bright, and fairly expensive. Coated boards are coated on one or both sides, usually with china clay. In addition to these boards there are several other kinds, such as strawboard for mounting and binding; mill boards made from wood pulp, fibre and other waste materials. Their dark colour precludes their use in printing.

Paper is made in standard sizes, and these sizes have now been agreed on by the paper-makers' and printers' associations. These sizes have common sub-divisions which are derived from the original mill sheet. The names of these sub-divisions are common to *all* standard sizes; the standard sizes have their own names. The commoner sizes are:

	ins. ins.
Small Foolscap	$13\frac{1}{4} \times 16\frac{1}{2}$
Foolscap	$13\frac{1}{2} \times 17$
Post	15×19
Crown	15×20
Large Post	$15\frac{1}{2} \times 20$
Small Demy	$16\frac{1}{2} \times 21$
Demy	$17\frac{1}{2} \times 22\frac{1}{2}$
Medium	18×23
Royal	19×24
Small Royal	20×25
Super Royal	$20\frac{1}{2} \times 27\frac{1}{2}$
Imperial	22×30

Boards are usually made in Royal; drawing paper in Imperial.

Paper is often made by the mill in larger sheets than the standard sizes, and sold to the printer in sizes which are either double or quadruple the standard size. Thus Double Crown 20 in.×30 in., Quad Crown 30 in.×40 in. The printing of a larger sheet, of course, reduces machine-running time on printing presses.

The following shows the various multiples and sub-divisions of any standard sheet and how they are obtained. S = the short, and L = the long dimension of the sheet:

Quad: multiply S by 2, L by 2.
Double: multiply S by 2.
Folio: divide L by 2.
Quarto: divide L by 2, S by 2.
Octavo: divide L by 4, S by 2.
16mo: divide L by 4, S by 4.
Long Quarto: divide L by 4.
Long Octavo: divide L by 2, S by 4.
12mo: divide L by 3, S by 4.
Long 12mo: divide L by 6, S by 2.
Square 12mo: divide L by 4, S by 3.

Books are normally printed from standard sizes of paper, commonly crown, royal, or demy, or their multiples. When the sheet is folded two *folio* leaves (or four pages) are made. A second fold across the longer dimension produces four *quarto* leaves (or eight pages); a third fold, eight *octavo* leaves or 16 pages. Thus we have a folded sheet in which there are four leaves which are free and four which are closed by the fold at the fore-edge; all being closed by the fold at the head. These closed ends or *bolts* are removed in the bound sections (before the case or cover of the book is placed on it) by a guillotine or cutting machine. This is called the trim, and explains why books are usually smaller in size than the standard sizes of paper.

Paper is sold by weight, and supplied in reams of 480, 500, or 516 sheets. An agreement between papermakers and printers determined that all paper should be sold by the thousand sheets, and that paper should be packed in 1000, 500, 250, or 100 sheets, but this has not been generally observed.

Paper is hygroscopic, i.e. susceptible to the humidity of the atmosphere. Humidity, therefore, has a large effect on paper, and most of the printer's trouble with paper is due to variations in relative humidity. Relative humidity is the relation of the amount of moisture in the air to what it is capable of holding at the same temperature and pressure. It is increased by lower temperature and decreased by higher temperature. To be in the best condition for printing, paper should be conditioned from the dry side to equilibrium with an atmosphere 5 to 8 per cent. higher in relative humidity than the pressroom atmosphere. The combination of an air-conditioned pressroom with a paper containing 0·5 per cent. excess moisture is considered the best solution of troubles arising from paper on the printing machine. Paper is conditioned at the mill if it is not matured. The best course is to condition it in the printing works. Any alteration in the relative humidity will cause the paper to have wavy edges, usually due to increase in humidity. If the relative humidity is reduced, the paper may curl (with subsequent feeding and registering troubles); static electricity and web-breaks in newspaper plants may also occur. Humidity may be increased by lowering the temperature, water-spraying, sprinkling floors and hanging up wet blankets and reduced by raising the temperature.

Static electricity in paper arises from friction, pressure, and rapid movement both during manufacture and use. It also develops in dry paper and dry atmospheres. Sufficient moisture-content in a suitably moist atmosphere prevents it, and static neutralizers on

printing machines are also used. Other remedies which have been suggested are to damp the paper, to coat parts of the printing machine with glycerine, to earth the charges on the paper by placing earthed electrical conductors near or touching the paper as it passes through the printing machine, and to use fabricated sheets for make-ready and draw sheets made from a pulp containing particles of metal which conduct the electricity through the press cylinders and frame to the ground.

Static electricity may cause trouble in rotagravure printing by developing sparks which may ignite the inflammable vapours given off by the ink. In letterpress work the sheets may stick on the feed-board and hamper automatic feeding; the sheets may also stick to the tapes or flyer sticks of the delivery mechanism. In web-fed rotaries static electricity causes folding difficulties. On lithographic machines the damping of the paper in printing and the moist condition of the air around the machine (caused by the evaporation of water from the damping mechanism) eliminate troubles from this cause.

The difficulty of importing wood pulp has led to a greater use of waste paper. Before the war, 85 per cent. of paper was destroyed; the remainder was largely used for the manufacture of cardboard and corrugated paper. There is no technical difficulty in de-inking paper and its adoption in the future will depend upon the supply of raw materials available in the next few years. A de-inking plant at Wolvercote has been successfully operated for some time and a strong paper of good colour is made there from ledgers, old cheques, and good book-paper waste, without special treatment of the waste apart from preliminary shedding. The large circulation of periodicals which are printed on papers that are wood-free has enabled de-inking plants to operate quite successfully in the U.S.A. Few magazines on pure paper are printed in this country, and their lower circulations do not provide any considerable amount of salvage in wood-free paper. Other waste consists of several kinds of paper which are not easily collected, whereas considerable waste in the American magazines is uniform and easier to collect. To remake the waste in this country and maintain uniformity of product raises difficulties which are absent in the U.S.A. Proposals have been made for the use of printing ink which is more easily de-inked. Moreover, the scarcity of petroleum, coal-tar spirits and other products may mean the introduction of water inks for photogravure and rotary printing from rubber stereotypes, or the use of logwood and iron oxide bleachable black inks.

Ink

Printing ink consists of a finely ground pigment dispersed in a vehicle or medium, and in certain cases, driers.

Pigments are obtained from earths (yellow ochre, green, umber, sienna, brown), from natural plant dyes (indigo, alizarine, carmine), and minerals (ultra-marine, cobalt, prussian blue, chrome yellow).

Until the nineteenth century, most synthetic colours were obtained from minerals. The first organic dye was discovered in 1856 and derived from coal-tar, the principal derivatives being aniline, naphthalene, and anthracene, from which a wide range of brilliant colours are produced. Dyes can be combined with metallic salts to produce pigments which are known as lakes. They are manufactured by precipitating a dye-stuff on to a transparent base, such as alumina hydrate or a mixture of alumina hydrate and barium sulphate.

The selection of the appropriate dry colour is important. Inks for printing soap-wrappers or paper to be mounted on strawboard (both of which contain alkali), matchboxes (where sulphur and phosphorus are present), posters which are subjected to strong light, need to be prepared to suit these conditions. Wrappers to contain food must be printed in inks which are free from lead, arsenic, copper, zinc, or other poisonous substance.

The most widely used ink is, of course, black, and carbon black is the pigment used. It is made from natural gases found in America. The gas is passed through oil to remove impurities and is burnt in small pure gas burners in huge burning-houses as a sooty flame which impinges on a cool surface. The soot collects on a moving steel ceiling, which oscillates, and it is removed by scrapers into hoppers and conveyed to a packing house. The density of the black is varied by the air burnt with the gas or by altering the gas burner. Carbon black of a cheaper grade is made from lamp-black by burning crude oils.

The vehicle used in most printing inks is made from linseed oil from crushed flax seed. It has great luminosity but low penetration. The fatty acids which it contains give it natural drying or oxidizing properties, and absorb oxygen from the air which converts the oil into a tough elastic film of linoxin.

Another vehicle is rosin oil or rosin varnish, a by-product of turpentine, which is used in cheap inks. They have great penetration, hold the pigment well, but do not oxidize readily. Mineral oil does not oxidize or give lustre but helps to keep ink stiff. White spirit gives flow to ink, reduces tackiness, and assists penetration. Gum varnish

helps to keep inks stiff and enables them to dry bright on hard papers.

Ink is made by mixing the correct proportions of pigment and varnish to a heavy paste. The paste is put through an ink-mill consisting of rollers of hardened steel, which grind it, while the necessary reducers, driers, etc., are added. Ink is checked for colour strength, consistency, and drying time.

There are two kinds of driers commonly used to-day, paste and liquid. Paste is used normally for hastening drying, but a liquid, usually cobalt drier may be preferred for black inks or inks used on a hard non-drying surface such as bond paper, cellophane, etc. Driers readily absorb oxygen and transfer it to the linseed oil (which also oxidizes), thus accelerating the drying of the ink on the surface of the paper.

Printing ink must, of course, be suited to the paper to be printed on and the process by which it is printed. The surface of paper, as we have already seen, is determined by the material from which it is made, the amount of beating, sizing, or coating. Ink dries by *absorption* into the paper, *oxidization* by combining with the oxygen in the air, and *evaporation* of the vehicle in the ink. Drying is also affected by the amount of pigment and drier in the ink, the temperature of the pressroom, and the age of the ink; black ink tends to lose its drying properties if kept too long. Papers which are little sized, such as newsprint and featherweight antiques, need a ready flowing and penetrating ink which is tacky (but not enough to pull the fibres), and which will dry by absorption and not set-off or show through.

News inks are made of carbon black, mineral oil and rosin. The quick-setting news inks contain a fluid non-drying mineral oil which penetrates rapidly into the soft fibres of the paper.

Although the invention of a solid ink binder dissolved in a highly volatile hydrocarbon solvent (in which evaporation restored the ink binder to its solid condition) solved the problem of a suitable ink for rotagravure, this kind of ink could not be used for newspaper rotary printing, as the solvent could not be stabilized on the exposed inking arrangements. The advances made by the use of nitro-cellulose, synthetic resins and solvents, were used by ink chemists in their efforts to discover whether these fast-drying and pigment-binding vehicles could be employed in printing inks, and so avoid smear and set-off on the paper reel.

One of the results was a vaporizing ink which consists of a solid rosin (the vehicle) and a high boiling solvent, which dissolves the rosin into a varnish and ensures the stability of the ink on the press.

The rosin in the ink on the paper is solidified by converting the solvent into a vapour by heat applied from a series of burners close to the paper reel or by other devices. The vapour is drawn off by an exhaust, and cooling drums re-cool the rosin on the reel. These advances have been advantageously exploited in modern magazine printing.

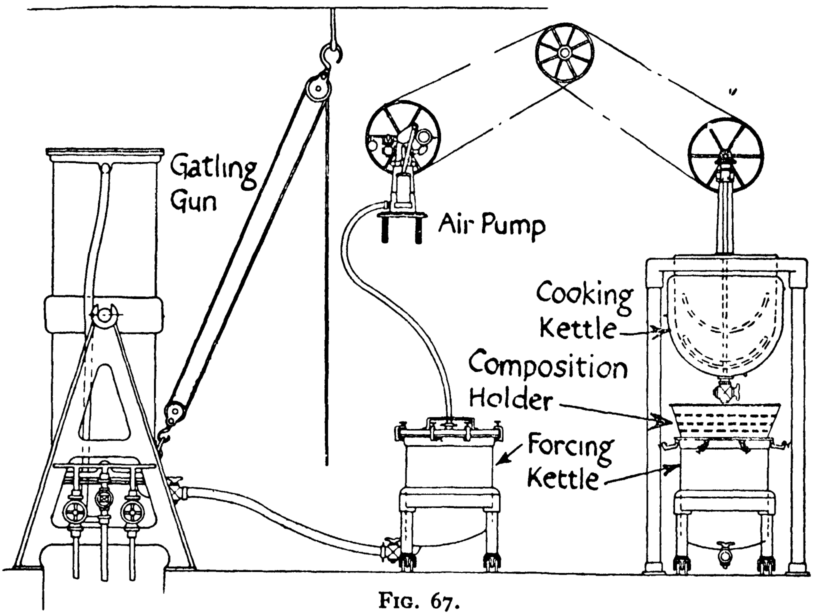


FIG. 67.
Roller-making equipment.

Another contribution to high-speed printing is an ink and apparatus which sets the ink by cold. Cold-set printing dries the ink by freezing it. The ink starts as a solid and ends as a solid on the paper. The fountain and inking arrangements are all heated by hot water from within to keep the normally solid ink fluid and controllable. When the hot ink touches the cold paper, it solidifies without penetration. Paper surface matters very little, and there is little squash or penetration due to fibre suction as with liquid ink. Penetration may,

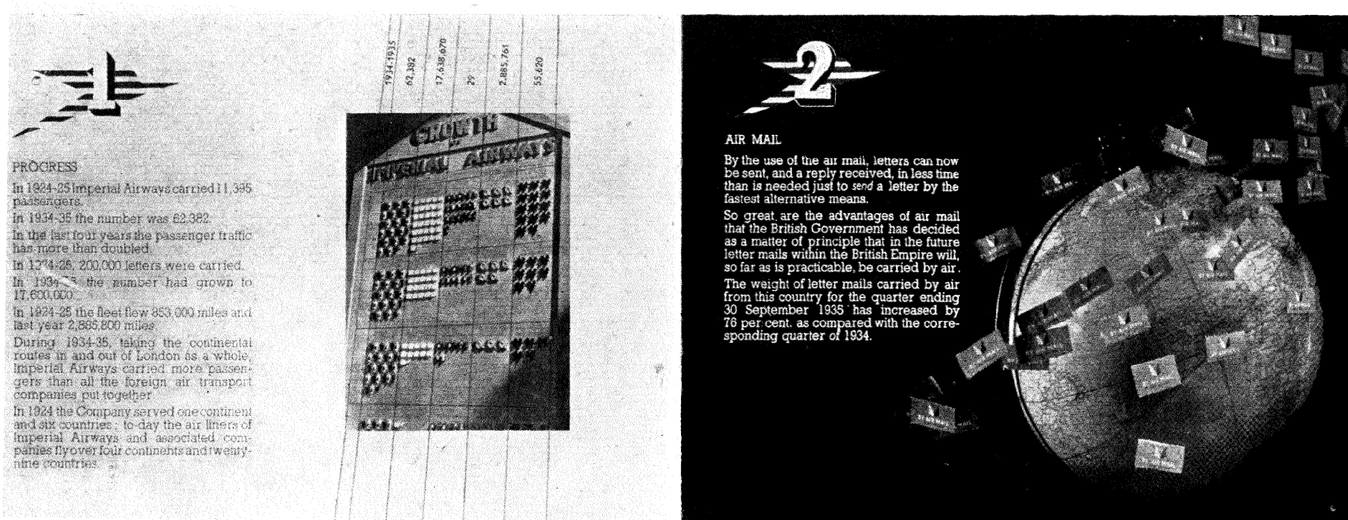
PLATE XXIII.

A black-and-white impression of an advertising folder (1934). The original is in black, red and blue. A fresh and lively technique developed by a group of artists working in Zurich in the early 'thirties. Drawing is used in conjunction with photography and the influence of abstract painting is apparent. Great skill is demanded from the photo-engraver.

PLATE XXIII


SPORTS INVERNALI IN ISVIZZERA
30 % Riduzione speciale
sui biglietti svizzeri

PLATE XXIV



Double-page opening from a booklet designed for Imperial Airways by Moholy-Nagy (1936). The original is in black and red. This artist, well-known as a 'constructivist' painter and experimental photographer, was one of the pioneers of typography reform. A fine example of modern design in printing.

however, be obtained by heating the paper after printing. The cold-set process eliminates strike-through, which is one of the bugbears of newspaper printing. The ink is supplied as a solid and broken up into lumps, and these are placed in the ink fountain, which is water jacketed and isolated and circulated with hot water at about 200° F. This reduces it to the required fluidity. Ink cylinders, vibrators, and plate cylinders are similarly fed with hot water; the rubber cylinders are not heated, but the surfaces soon rise to the same temperature by contact. It is said that all types of web presses can be converted to this method of printing. The need for any set-off mechanism is, of course, eliminated.

With the majority of ordinary printing papers, which are soft-sized, an ink is ordinarily used which will just penetrate, set quickly, and dry mainly by oxidization.

Papers with hard-sized surfaces, such as banks and bonds, writing papers, greaseproof, flint-glazed, and glassine, require a stiff tacky ink, strong in pigment, that will adhere, dry hard by oxidization, with the minimum amount of set-off.

Art or coated papers require a short but not tacky ink that will print without plucking away the coating, just penetrate, set quickly, and dry hard by oxidization. The pigment needs to be finely ground so that the smallest half-tone dot will print clearly.

Lithographic inks are stouter and contain more pigment than letterpress, as the lithographer usually reduces them himself. It is, of course, important for the pigment to be insoluble in water. Gravure inks are thin, spirituous, and dry quickly by evaporation. Highly volatile non-inflammable solvents are also used. The enclosed ink fountain avoids waste of solvent through evaporation and protects the operator from the toxic effects of the ink.

The development of printing machinery would not have been possible without the invention of the inking roller. In early printing the forme was inked with inking-balls or circular pads of cotton or hair, covered with some material such as leather, and provided with a handle. At the beginning of the nineteenth century, it is said, a printer spilled some treacle on his inking ball and discovered that it resulted in improved printing. A compound of treacle and glue was used for transferring designs on earthenware, and ink-balls were made from this compound. It was Edward Cowper (1818), however, who made the first composition roller for hand-use, and the firm of Harrild were probably the first to sell them to the printer. These early rollers were made by pouring the composition into brass tubes,

but later moulds were made by boring and polishing cast-iron, and split moulds were introduced to facilitate the removal of the rollers from the moulds.

The modern roller owes much to Samuel Bingham and James Rowe. Their apparatus (Fig. 67) consists of a steam-heated cooking kettle with a mechanical stirring device, and a forcing kettle into which, through strainers, the composition flows from the cooking kettle. The cooking kettle has an air-tight lid and a hose attached to the bottom to connect with the roller moulds. Air pressure, applied by means of a pump, is used to force the melted composition from the forcing kettle into the moulds. The moulds are contained in a 'gatling gun,' and are made of polished brass or steel. They are set in the gun inside an iron tube with a surround of cement forced in by pressure to prevent movement or bending. The gun may be swung into convenient positions for cleaning, oiling, loading with stocks (the spindles on which the composition is moulded), and unloading the finished rollers. Hot and cold water are connected to the cylinder as the moulds are heated to receive the hot composition and cooled after filling. The composition (glue, gelatine, glycerine, etc.) is stirred and cooked in the cooking kettle, strained and transferred to the forcing kettle, which is connected by the hose to the gun, and forced *upwards* (to exclude air and bubbles) into the moulds assembled on the gun. The moulds are oiled, and when cast, the rollers drop out under their own weight. This system was first used in this country about 1897.

Inkless Printing

Experiments have been made from time to time to print without ink by forming an electric circuit between the type and the printing press, the 'impression' being in the nature of a burn; also by passing Röntgen rays through a chemically treated pile of paper, first on one side and then the other, but so that the lines on the reverse side of the sheet fall between those on the other side. These experiments seem to have proved abortive. In the *Technique de l'Imprimerie* (1939) a method was mentioned for printing piles of paper electrically. A special negative is placed on the pile and an electric current passed vertically through it by means of two electrodes, on the same principle as ordinary photographic print-making, opaque parts of the negative being impermeable to the current. The other side of the paper is printed by reversing the pile and using another negative.

CHAPTER XIV

DESIGN IN PRINTING

IF a proper appreciation is to be gained of design in printing to-day it must be studied from several points of view. First, one must know where the responsibility for the design lies. The early printers were responsible for both design and supervision of the execution of what they printed. To-day the responsibility for the design of a piece of printing may rest at any point in the production, from the individual who commissions it to the printer, in the person of a lay-out man, foreman, or compositor, who prints it. It may even be initiated and planned by some one remotely connected with them.

A considerable section or modern printing consists of an attempt to reproduce paintings and drawings which were originally executed without any view to reproduction, such as, for example, paintings by the old masters, contemporary paintings, or paintings adapted for use as posters. In these cases the design is already determined, and the printer is only concerned with technical excellence in reproduction. It has to be admitted that nothing more than an approximation has yet been achieved. 'No form of reproduction,' says one of our finest landscape photographers, Mr. J. Dixon-Scott, 'can ever do justice to the original print,' and contemporary painters have despaired of obtaining anything more than a transcript of their original intention. Reproduction by printing processes must be accepted as a convention in the same way that a photograph is accepted as a tonal equivalent of the subject, and that the gramophone record is accepted as the closest approximation to the living artist or group of artists.

Somewhat removed from this sphere is the considerable quantity of printed matter which reproduces paintings, drawings, or designs executed by so-called 'commercial' artists expressly for the purpose of reproduction. In recent years artists have learnt much more about the limitations and capabilities of printing processes and materials, and have restricted their own materials in accordance with the nature of the method of reproduction. The rise of the skilled 'commercial' artists, many of high reputation, has been one of the remarkable features of the past twenty years. In large part they have been responsive to vital movements in modern painting from which their inspiration has been drawn, and they have been the

greatest single influence on the improved standard of printed matter seen by the public. Examples of their work may be seen in posters, showcards, advertisements, and so forth. Their special gifts and high proficiency may be judged by the complete failure of the 'academician' who attempts such work. The 'commercial' artist is supported by a number of 'typographers' or specialist-designers of typography, usually drawn from the printing industry to work in advertising agencies and studios, although their work is subsidiary and has much less influence on design. The whole of the work is usually co-ordinated by an art-director.

In the field of book-production the work may be conceived as an integral whole and planned in accordance with the industrial resources of the printing plant. A good deal of bookwork to-day is planned and supervised by production-managers. Generally speaking, the canons of format have been established by tradition, and their modification for contemporary needs has resulted in a very high standard of commercially produced book. In the generality of book production no further experiment is of much value, although there is always scope for fresh treatment within this more or less narrow convention when exceptional occasion demands it.

There remain one or two general printers who may be regarded as exceptional and who have managed to retain the responsibility for the design of the work that they execute. These concerns are often dominated by a master-printer or director with considerable ability in design.

Newspaper design, however, has undergone radical change, a change that is reflected in periodicals. Few newspapers now attempt to retain the 'vertical' layout of the traditional early newspaper, consisting of long narrow columns and single-column headings, unrelieved by two- and three-column headings, although some local papers of the kind may still be seen. The popular newspaper has now adopted the 'horizontal' layout where the columns are broken up into two, three, or more column headings, with occasional 'streamers' or 'banners' which stretch across the whole width of the page. This flexible and more dynamic treatment is in the nature of improvisation arising from psychological experiment. The new style is enhanced by the use of capitals and small letters in place of uniform headings in capitals only, and a freer treatment of the lines in place of centred and pyramidal arrangements.

There is another aspect of design which, although it is rapidly developing in other fields of industry, has hardly affected printing.

The last decade or so has seen the appearance of the industrial designer who, besides a practical knowledge of the technique of modern production, scientific management, and perhaps engineering, has an aesthetic background of training or ability in the arts either as a painter, architect, or graphic artist. A large proportion of consumer-goods now being manufactured are designed by such men. They analyse the productive capacity of a plant and discover its potentialities and its unavoidable weaknesses. Their efforts are then bent to the designing of a product which shall approximate to a co-ordination of fitness to purpose together with pleasing or even exciting appearance, and, at the same time, conserve the utmost economy of time, material, and cost in the factory. Such a design may involve reduction in the range of models (often with proportionate reduction in cost and price) and, because the design has a wider appeal, result in spectacular increases in sales.

As printing gradually becomes more and more industrialized in the larger plants, rich opportunities will open up for the designer who can visualize printing work in terms of production. In smaller offices the inevitable persistence of some degree of craft practice will stave off complete industrialization. Generally, however, there is bound to be some form of rationalization or standardization of material and methods which will, at least, preserve the printer from the whims of his customer in the choice of type faces, style of display, size of paper, and so on. Compositors will be trained to follow a house style; paper sizes will make full use of the capacities of presses; scientific analyses of time and motion will form a praxis of factory discipline.

Travellers will consequently be able to *sell* printing, standardized printing, and will no longer be passive recipients of customers' instructions. Thus the printer will not be hampered by styles of work and industrial techniques which do not comfortably conform to the flow of work. The designer will, in short, conceive production in terms of 'flow,' which is, of course, the basis of modern mass production. Whether it will ever be possible to introduce 'belt production' into the printing industry is perhaps doubtful, but there are keen minds who are concerning themselves with the underlying principles in an effort to apply them to this end.

Experiments have been made and at least one American magazine has been designed along these lines. The high cost of hand-work in 'make-up' was avoided and, as far as composition was concerned, the whole work was set to a single width on a slug [Linotype] machine.

Printing designed in such a way would be simpler but could, nevertheless, be pleasantly readable and thus quite as fittingly fulfil its purpose. In the logical, if perhaps ruthless, pursuit of this new ideal in industrial design there will most certainly be ample opportunities for reducing the cost.

The influence of abstract painting on all forms of design was also felt in the graphic arts. Abstract painting is painting without a set subject. In a naturalistic painting there are two elements: the objects portrayed and the subject of the painting. A good painting, has, of course, also an interesting interrelation of colours and forms. In abstract painting, notably in the simpler ones, there are elements clearly defined in form and colour and in relationship to one another. The aim of the new typography was to create similar subtle arrangements of simple yet strongly contrasted elements within the bounds of its own technique. This technique normally demands restriction to the elementary direction-contrasts of the horizontal and vertical, and these were largely exploited to obtain a maximum of visual impressiveness and subtlety. Where desirable other angles or direction-contrasts were used.

The history of this development may be studied in the Russian 'elementary' typography of 1926, the Budapest MA group, the Bauhaus School (under Walter Gropius, founded in 1923), Tschichold's *Die Neue Typographie* (1928), and in the issues of the *Deutsche Mitteilungen* (which was largely instrumental in bringing these new ideas to the trade) at this period. Much of the earlier work was violent and experimental, which was to be expected, but its influence is profound and may be seen in almost every jobbing printer's work. This new influence, although developed mainly in Germany, was, nevertheless, an international movement.

This influence was of two kinds. First, an attempt to give words a greater expressive power, and, second, the gradually growing tendency to relate all forms of design to contemporary purposes. The new school insisted on the fundamental unity underlying all branches of design, and the interdependence of all forms of creative art in the modern world.

Thus design in printing draws its inspiration from all sources, and depends (as it has always depended) chiefly on the æsthetic, social, and economic standards of its period. It is only by the use of a rational judgment, attuned to the needs and ambitions of his contemporaries, that the designer of printed matter can usefully exercise his talent, and there is scarcely any style, influence, or stream of

thought that will not enrich his contribution. The storm of the more experimental 'modernism' having passed, the atmosphere is now cleared of many meaningless traditions and craft preoccupations in printing design. The principles that were enunciated can be widely applied in this age of mechanical invention and industrialization. The newer trends in art and industrial design have brought about the realization that, whatever styles may eventually be exploited, they will need to be capable of mechanical execution by modern machinery, methods, and materials, and this principle may be said to be the dominant characteristic of modern work in almost every sphere of printing to-day.

A NOTE ON MODERN TYPOGRAPHY

By BERTRAM EVANS

It is unfortunate that a more descriptive term than the 'modern movement' is not commonly used to denote the renaissance of design in the visual arts, which have indeed been born again in the present century. The word 'modern' has been used as a cloak for so much that is meretricious and is often a plain offence to people of sense and sensibility.

There can be little doubt, however, that as the last century waned, the arts—those elevating activities where skill is tinged by the sublime—had become pre-occupied with their own traditions and thereby had lost touch with the contemporary habit of life. Artists and designers in every sphere, including the art of printing, were intent on producing vain repetitions of what had been accomplished in the past, with no apparent concern whether their work possessed any correspondence with the times in which they lived.

It is easy to illustrate this divorce from life in the practice of printing where tradition is entirely derived from the printing of books. Mr. Tarr has shown the confusion arising in the early nineteenth century from the failure to recognise that some quite different form than a book title-page was called for by the new demands of commercial printing.

To-day, apart from books, newspapers, and magazines, the mass of printing falls into two main classes: advertising matter of all kinds, and printing required by the routine operations of a business, which may aptly be called 'utility' printing.

Consider the actual literary matter of any piece of current advertising printing. Clearly in form and style it is entirely without precedent and the structure of a book title-page is utterly inadequate to contain it. Here is new wine that must have new bottles.

So also with the 'utility' printing essential to the running of a complicated business. Upon a co-ordinated system of printed forms and cards, records are made which, when properly designed, will present a kinetic representation of the day-to-day operation of the business and enable the executive to pass under review the contemporary facts of the business. This kind of printing has never been required until the rise of modern business, and it must be designed expressly to fulfil its present purpose.

In the early years of the twentieth century the vision began to clear and the dry bones of architecture, painting, sculpture, and of industrial design that is formed in the womb of these arts, began to stir. Nowhere did the dominance of the past press more heavily than in Italy. In that land, bearing the double weight of classical Rome and of the Renaissance, a group of young men sprang up, calling themselves Futurists—men with a faith in the future. 'We wish to destroy the museums,' they extravagantly proclaimed, 'the libraries . . . we would deliver Italy from the canker of professors, archæologists, guides, and antiquaries.'

In 1912 their poet-leader, Marinetti, declared, 'I am about to initiate a revolution in typography . . . directed against so-called typographic harmony.

My typographic revolution allows me to give words all the speed and power of aeroplanes, trains, waves, of explosives, of the sea spray, of atomic energy.'

About the same time in Paris, the Hebrew poet who wrote under the pseudonym of Apollinaire was printing his poems in somewhat startling typographic style.

During the 1914–18 war a number of young men, of various nationalities, who mostly had sought refuge in Switzerland from military service, were meeting in Zurich cafés. They called themselves Dadaists and issued manifestoes in 'revolutionary' forms of typography. To them the world seemed like a mad-house, and the only way to reduce it to order was to become part with disorder themselves. They were fanatics in the Temple

FIG. 68.
Dadaist advertisement from a German newspaper, 1920.

of Unreason. In 1916, a slight Dadaist publication, called *Blast*, appeared in London. The Dadaists' notions of typography faithfully reflect their irrational creed.

In retrospect the typographic experiments of the Futurists and the Dadaists do not appear to have more significance than the pranks that enthusiastic compositors have often delighted to perform for their own entertainment, and it is difficult to discover in them even the embryonic forms of the later new typography.

At the close of the last war, due to an unusual concatenation of circumstances which I have discussed elsewhere,* the *avant garde* flocked to Germany, and there, on German soil, a Continental movement sprang up, in which a new and living graphic art was born. Germany, at the beginning, played but a small part in this awakening.

In 1919, the German Professor Gropius, by the amalgamation of the

* Royal Society of Arts Cantor Lecture, 'Modern Typography on the Continent,' 1938.

Weimar School of Arts and Crafts and the Weimar Academy of Art, founded the famous *Bauhaus* (afterwards removed to Dessau), his guiding principle being the ' idea of the fundamental unity underlying all branches of design ' and the ' common citizenship of all forms of creative work, and their logical interdependence on one another in the modern world.'

Until it was suppressed by Hitler, the influence of the *Bauhaus* was great. It spread throughout the world. All the notable artists and designers striving to create new forms were in contact with their organisation. The typography originating at this centre (a minor part of their activities) was known as ' elementary ' typography, since it reduced type and its arrangement to their simplest elements. Sanserif types only were used, ornaments were

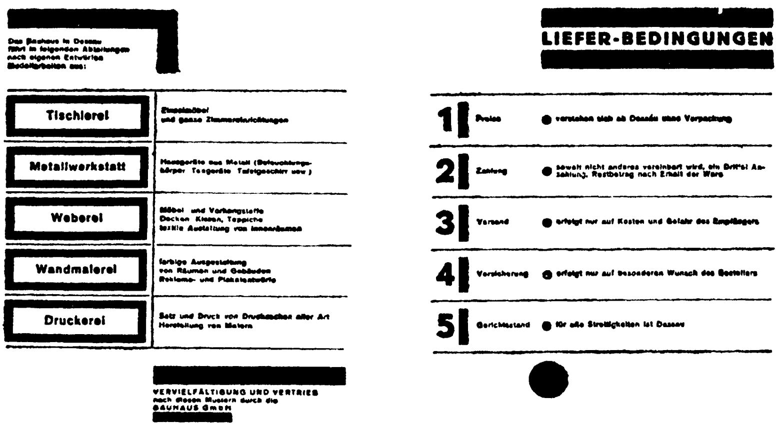


FIG. 69.
Pages from the Bauhaus prospectus, 1923.

rigidly excluded, and (other than letters) the only typographic material permitted was simple geometric shapes, such as squares, circles, arrows, and bands.

Much of the inspiration was drawn from ' abstract ' painting, in which the artist depicts no subject, but is concerned only with composition, form, and colour. As the abstract painters had no story to tell in their pictures, so the elementary typographers aimed to make a purely *optical* impression, and attempted to silence all echoes of the human voice from printed words. Such was revolution indeed, for words have always been regarded as symbols of sounds. There is little in literature that does not gain from being read aloud.

Most important, however, was the substitution of the asymmetrical for the symmetrical in typographic design, with the object of inducing a sense of the dynamic instead of a feeling of rest. Most books are intended to relax the reader, even when they call for sustained attention ; the advertiser wants to rouse him. The Futurist painter endeavoured to stimulate the actual sensation of movement in the spectator,* to infuse their pictures

* In his recent book, *The Film Sense*, Eisenstein has an interesting discussion on the dynamic principle that ' lies at the base of all truly vital images even in such an apparently immobile and static medium as, for example, painting.'

with dynamic energy, and it is this conception of 'dynamic' composition (or layout, as the printer calls it) which is the most readily distinguished difference between modern and traditional typography. The dynamic effect is enhanced also by regarding paper not as a passive background, but as an active element in the design. The paper is considered from edge to edge, and white intervals of space become as important as black areas of type.

The main problem of all pictorial composition is that of balance. In traditional typography the centre of balance is equidistant between right and left and all lines are centred. The problem of balance is therefore comparatively simple. But when the main point of balance may be anywhere on the page, the problem of balance is complex. The gain in immediate lucidity, however, is enormous. It is always possible in this way so to arrange the message that the main points at any rate can be apprehended in a single glance of the eye, and this is what the present-day advertiser demands. One reason for this is that when all the lines of type are centred the eye must travel to a different place to pick up the beginning of each successive line, since the lines are uneven at the left-hand side. This is fatiguing. In asymmetrical design the tendency is to range the beginnings of the lines on one or more imaginary vertical lines, and the eye travels easily to the same place. A good illustration of this point is seen in Mr. Tarr's example on page 83.

Among those who were early converts to the teaching of the *Bauhaus* was a teacher of orthodox lettering at the Leipzig Printing School, Jan Tschichold, who was to become the most ardent and perhaps the best-known advocate of the new typography. In 1925 he edited a special number of the German trade-union publication, *Typographische Mitteilungen*, propounding the new principles. In 1928 he published his first book, *Die Neue Typographie*, and developed his thesis further in *Eine Stunde Druckgestaltung* (1930) and in *Typographische Gestaltung* (1935). In 1925 Tschichold transferred his activities from Leipzig to the Munich Meisterschule where Paul Renner was Principal, a man who had grappled courageously with the problems of art in a machine age, and typography in the modern world.

The simpler forms of the new typography were economical in time and the labour of type-setting, and thus made considerable appeal to those who were pursuing the process of rationalization in German industry. Furthermore, as an understanding of the new principles permeated the printing schools, they became so formulated that they could be generally accepted throughout the German printing industry.

German typefounders were astute enough to discern the way the wind was blowing, and benefiting from the expansion of bank-credits which was made possible by huge American and British loans* following the acceptance of the Dawes Plan in November 1924, they endowed the printing trade (1926–1932) with a wealth of splendid sanserif type designs, to be followed by literally hundreds of other original type designs, such as the printing industry has never known. It is an amazing episode in the history of printing.

The new typography spread through Europe, though little understood in

* 'Why American bankers induced their hundreds of thousands of clients to buy two billions of German bonds or why they granted such huge short-term credits between 1924 and 1930, I cannot understand on any other grounds than that they were willing to risk their people's savings in order to make huge profits themselves.'—Ambassador Dodds' *Diary*, p. 147.

this country and scarcely better, until recently, in America. Fine work has been done in Italy and Czechoslovakia. El Lissitzky, one of the original Dadaists, became prominent in Russia, possibly deriving some of his inspiration from the ' constructivism ' of the pre-war Moscow theatre.

No one supposes that the new doctrines will entirely displace the dogma of printing tradition or that asymmetrical design can usurp the place of symmetry. It may be that the instinct for symmetry is deep in human nature. But tradition that does not progress denies its own name. The permanent gain to the art of printing from the vivifying influence of the new typography is considerable.

GLOSSARY

antique (*paper*), a term originally applied to denote the colour and finish of machine-made paper; now denotes any good bulking paper with a rough surface.

aquatint, an etching process on steel or copper resembling a drawing in water-colours, sepia, or indian ink.

arabic figures, the figures commonly used (1, 2, 3, etc.) as distinct from *roman* numerals composed of letters (I, II, III, etc.).

art (*paper*), paper coated, after making, with a composition of china clay or kindred mineral which fills up the unevennesses in the surface so that half-tone engravings may be printed on it; usually shiny.

ascender, the ascending part of such lower-case letters as b, d, f, h, k. l.

bed, the table of a printing machine or press on which the forme lies when it is being printed.

black letter, a general term used to describe a gothic or Old English type design.

block, a general term used to describe any letterpress printing plate.

block-book, a book printed from hand-cut or engraved wooden blocks containing both illustrations and wording.

board, a thick stiff sheet of paper composed of layers of paper pasted together. Also called pasteboard, pulpboard, cardboard.

body, the measurement (or thickness) from top to bottom of a type, slug, lead or rule. Also the shank of a type; the text of a volume.

bowl, the full rounded oval or circular part of a letter, complete in O or modified in D, B, a, b, d, etc.

brayer, a hand ink-roller.

broadside, a large sheet printed on one side only; a poster.

calendered (*paper*), the glazing or polishing imparted to a paper surface, after making, by passing the sheets or web through a stack of cylinders (or calenders).

calligraphy, fine writing, penmanship.

carriage, that part of a printing machine or press which carries the forme backwards and forwards to receive the inking and impression.

case, a receptacle for housing movable types from which a compositor sets type; when in pairs the upper case holds capitals, small capitals, etc., and the lower case holds the small letters, spaces, etc.

cast off, to estimate the space or number of pages that a given amount of wording or manuscript will occupy when set in type.

chase, a cast or wrought-iron frame into which type pages, etc., are locked for printing.

chiaroscuro, a method of wood-engraving and printing in which a number of blocks are used, each giving a different tint or hue.

colour separation, in engraving, the process of separating the parts of a photograph or drawing by means of colour filters, etc., that are to be printed in different colours so that a separate plate may be made for each colour and the plates printed in register to produce the original copy.

compositor, one who sets type, makes it into pages, and imposes the page or pages (i.e. locks them into correct position in a chase).

couch, a felt-covered board on which sheets of pulp are pressed in hand-made paper-making; to transfer sheets of partly dried pulp from the wire mould to a felt blanket for drying into a sheet of paper.

counter, the interior space of a letter, type, or punch.

counterpunch, an engraving in high relief of a counter which is punched into a punch to make the counter before the remainder of the punch is engraved. Punches are automatically cut in a punch-cutting machine to-day from patterns, and counterpunches are unnecessary.

cross-bars, bars (usually removable) which divide some chases into sections for the more rigid locking-up of several pages.

crown, a standard size of printing paper, 15 in. × 20 in.

dandy, a cylinder of wire mesh on a paper-making machine which comes into contact with the partially formed web of paper and impresses it with a watermark.

demy, a standard size of paper; printing, 17½ in. × 22½ in., writing and drawing, 15½ in. × 20 in.

descender, that part of a lower-case letter which descends, such as in g, y, p, q, j.

display, printed matter in which words are made prominent by size, weight, or position, such as title-pages, hand-bills, etc.

distribute (or 'dis'), to put back each letter and space into the proper box of its appropriate type-case after use.

distributor rollers, the rollers on a printing machine which distribute the ink on the ink-slab and transfer it to the inking rollers which ink the forme.

doctor blade, a thin flexible steel blade which scrapes the superfluous ink from the plate on a photogravure or intaglio printing machine.

draw sheet, the sheet which is drawn over the 'make-ready' on the cylinder of a letterpress printing machine.

drier, substance added to printing ink to regulate drying.

duct, a reservoir which contains the ink on a printing machine and from which it is taken by the distributor rollers.

electrotype, a facsimile plate of a type forme or another plate made by taking an impression in wax, depositing on the wax a thin sheet of copper by electrolysis, and backing the copper sheet with type metal.

em, the square of the body of any size of type; the depth of the body of the type in use (e.g. 15 ems of 9-point); the standard unit of typographic measurement, when it then signifies a 12-point em (·166 in.), e.g. set to 18 ems wide (i.e. about 3 in.).

en, half the square of the body of any size of type. Two ens = one em. Used as a unit for casting up (i.e. computing the amount of type that has been set) composed type; type setting is charged at so much per 1000 ens.

esparto, a coarse grass imported from Spain and North Africa and used in paper-making.

face, the printing surface of a type; the particular design of a fount of type.

family, a number of series of related type designs which have characteristics in common.

feed-board, that part of a printing machine from which the paper is fed.

finish (paper), the amount of gloss or other treatment given to the surface of paper.

fitting, the degree of proximity that each type character bears to adjacent characters.

flong, sheets of papier mâché used for making moulds of type formes in stereotyping.

flowers (or *fleurons*), a kind of printer's ornament originally copied from the stamping irons (*petits fers*) used by early bookbinders.

folding chases, a pair of chases which are used instead of one large one for convenience in locking up large formes containing many pages of bookwork.

folio, a sheet of paper folded in half, across its longer dimension, from a standard size.

format, the size and shape of a page; also the size, shape, style and general appearance of a book or other printed work.

forme, type and/or blocks with accompanying furniture secured in a chase.

fount, a complete set of type characters comprising a number of each of a particular face and size.

fraktur, a kind of black letter type design used in Germany.

frame, a stand for holding type cases.

frisket, a cut-out sheet in a light iron frame joined to the tympan of a hand-press which folds between the forme and the paper being printed to prevent the paper receiving ink from lower parts of the forme, those other than the type and block surfaces.

furniture, wooden and leaden material used in blanking out pages and formes in the chase.

galley, a flat tray for holding composed type matter for make-up or for storage in a rack.

gothic, a name now generally given to bold sanserif and grotesque types.

graining, the process of preparing the surface of a lithographic stone or plate by oscillating, in a plate-graining machine, a number of glass or porcelain marbles with sand, glass, or pumice powder.

graver (or burin), a tool used for engraving wood and metal.

grippers, fingers on a printing machine which grip the edge of the paper and convey it to the position for printing.

groove, the hollow between the feet of typefounders' type.

grotesque, a type design without serifs and usually heavy and condensed.

hair-line, the thin strokes of a type character.

half-tone, a letterpress printing plate produced by a mechanical photo-engraving process on copper (or zinc), being a reproduction of a photograph, drawing, painting, print or other object having a gradation of tones. The surface of the plate consists of dots of various sizes uniformly placed and capable of rendering the effect of high lights and shadows and the gradations between.

height-to-paper, the standard height of type and printing plates in letterpress printing. In Great Britain, the Colonies, and the U.S.A. it is ·918 in.; on the Continent mainly ·928 in.

high-light, the whiter parts of a half-tone block, photograph, drawing, etc.

image, the subject reproduced or represented in a negative, plate, litho stone, or other reproductive medium.

impose, to put type pages in their correct order into the chase.

impression cylinder, the cylinder which holds the paper when it is impressed by the forme.

imprint, the name of the printer and place of printing, usually placed either at the end of a book or on the back of the title-page.

incunabulum (pl. *incunabula*), a book printed in the fifteenth century—the cradle period of letterpress printing from movable types in Europe.

inner forme, a forme containing the pages which fall on the inside pages of a printed sheet when folded and which is printed on the other side of the sheet by the *outer forme*.

interlay, a sheet or sheets of paper or other material placed between a printing plate and its mount for varying the pressure on different parts of the plate.

italic, a calligraphic or cursive form of letter which generally slopes down to the left.

jobbing, display work and commercial printing as distinct from bookwork and newspaper work.

justification, the equal spacing of words or blocks to a defined measure; the process of trueing a matrix when made by hand after it has been struck by the punch.

kern, that part of a type which overhangs beyond the metal body on which it is cast, such as the head and tail of some italic letters as *f*.

lead (pron. led), a thin strip of lead less than the height of type, used to separate type lines. Thicknesses: 1, 1½, 2 and 3 point.

letterpress, a method of printing from a raised surface from type or blocks as distinct from lithographic or intaglio printing.

line block, a letterpress printing plate, photo-mechanically engraved, consisting of solid areas and lines, reproduced from a black and white drawing without any intermediate or continuous tones.

liner, a piece of steel of the thickness of one of the standard sizes of type which are inserted in a Linotype or Intertype mould to determine the measure and the body of the slugs to be cast therein.

linocut, a relief block cut by hand in linoleum and mounted on a wood base to the height of type.
lock up, to fasten type and/or blocks in a chase by means of quoins.
lower-case letters, the small letters a, b, c, d, e, etc.

mainstroke or body line, the heavier lines of a letter; the principle stroke or stem of a letter.
majuscule, capital letter.
make-ready, the process of preparing a forme for printing by patching up with paper or cutting away on the impression cylinder or platen, and by underlaying and interlaying, so as to give the correct amount of pressure to the various parts of the forme.
make-up, arrangement of type and blocks or other material into a unit or pages.
matrix, a copper, brass or phosphor-bronze mould which has been struck by a punch and from which type is cast in a mould; a papier mâché cast of a forme.
measure, the width to which type matter is set.
mechanical wood (paper), a grade of wood pulp used in paper manufacture, prepared by grinding.
medium, a standard size of printing and writing paper, 18 in.×23 in.
minuscule, small or lower-case letter.
monochrome, drawing or illustration in one colour.

offset, a process of printing from a litho stone or plate by transferring the impression made on a rubber blanket to paper.
overlay, a sheet or sheets of paper placed on the impression cylinder or platen bed used to regulate pressure on different parts of the forme; a sheet of several thicknesses of paper (or an etched chalk-covered sheet) used for the same purpose.
over-run, to take over words from one line into the next for successive lines after a correction.

packing, the rubber blanket, tympan manilla, or other material placed on the impression cylinder to give sufficient general pressure for printing.
perfecting, printing on the second side of the paper.
planer, a flat smooth piece of wood which is placed on the forme surface and tapped to level it before locking up.
punch, a piece of steel engraved with a type character and used for stamping matrices.

quad (or *quadrat*), a type space used for blanking out lines of type. Usual sizes: en, em, 2-em, 3-em, 4-em.
quoins, wooden or metal wedges or expanding metal boxes used for locking up formes.

reel, a roll or web of paper as distinct from sheets.
register, to coincide or fit together when two or more formes are printed on the same sheet.

reglet, a thin strip of wood used for spacing.
resist, a coating applied to the surface of a plate in etching to protect it from the corrosion of the acid.
rotagravure, rotary photogravure.
rotary, a printing machine in which both the printing surface and the impression cylinder rotate.
rule, a strip of type-high rolled brass with a face finished to a continuous line or lines, made in various thicknesses and designs.

sanserif, a type design without serifs.
schwabacher, a kind of black letter type design used in Germany.
screen, a grid of opaque lines on glass crossing at right angles, thus providing transparent rectangular apertures between the inter-sections which split up the image into dots in half-tone engraving and which in photogravure provide (when the plate is etched) a surface for the doctor blade to ride upon.
serif, the short finishing stroke at the ends of letters.
set-off, the undesirable transfer of ink from one sheet to another by pressure. Not to be confused with offset (q.v.).
shank, the body of a type excluding the head which carries the face.
solid, type lines without any space between them.
stem, the mainstroke of a letter or character.
stereotype, a plate cast in metal from a papier mâché or plaster mould taken of type and/or blocks.
stone, a table with a planed iron (formerly stone) surface upon which formes are imposed.
stress, the thickening, vertically or biased, of a curved stroke in a letter.
stuff (paper), paper in pulp form.
swash letters, flourished or calligraphic letters seen in certain italic capital letters of such founts as Caslon and Garamond.

tympan, the frame on a hand-press usually covered with sheets of parchment between which sheets of paper are placed to vary the pressure and on which the sheet is placed when printing.
typographer, one responsible for the character and appearance of printed matter.

web, reel of paper as distinct from paper in sheets.

x-height, the height of lower-case letters (excluding descenders and ascenders), i.e. the height of a lower-case x.
xylograph, wood-cut block, particularly in early printing.

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